

THURSDAY, JUNE 25, 1885

## THE CHITTAGONG HILL TRIBES

*The Chittagong Hill Tribes. Results of a Journey in the Year 1882.* By Dr. Emil Riebeck. Translated by Prof. A. H. Keane. (Asher, 1885.)

THE visit paid by Dr. Riebeck to the frontier tribes between Chittagong and Independent Burmah in the spring of the year 1882 formed a mere episode in the great expedition to the Far East, from which he has recently returned, laden with ethnological treasures of all sorts. But this episode, carried out at the suggestion of Dr. Bastian, "prince of ethnologists," proved from a variety of causes so unexpectedly fruitful in results, that he has been well advised to publish a separate account of it, pending the appearance of a comprehensive work on his general travels in Somaliland, India, China, Japan, and other Eastern regions. In its arrangement, profusion of coloured and other illustrations, and especially in the treatment of the subject matter, this first instalment almost reaches the standard of ideal perfection—of such perfection as can be achieved only by patient and intelligent observation, and by the cooperation of specialists in their several faculties combined with a generous use of unlimited means. Certainly the principle of division of labour in literary and scientific work has never been more happily illustrated than in the present instance. Wisely limiting his own functions to those of a laborious collector and narrator of his personal experiences, Dr. Riebeck has placed all his rich materials at the disposal of the foremost naturalists in Germany, by whom the data thus supplied have been made a convenient text for so many separate monographs of great value on the various scientific aspects of the subject.

The work thus comprises, besides the journey itself graphically described by the traveller, four independent treatises—by Dr. A. Grünwedel, on the ethnology; by Dr. Rudolf Virchow, on the anthropology; by Prof. Julius Kühn, on the zoology; and by Herr von Danckelmann, on the meteorology of the hilly region traversed during the expedition.

The trip included altogether two separate excursions, the first from Chittagong up the Karnaphuli river to Pakhoma and Forts Sirtay No. 1 and 2, close to the Burmese frontier; the second, again from Chittagong southwards to the Sangu, up that river nearly to its source, thence across the border to Dalakmey on the Koladan in Arakan, and from that point down the Koladan to its mouth at Akyab. None of these river basins can be described as unknown regions, seeing that they all lie well within British territory, and have been frequently traversed in various directions by Lewin, Hunter, and other explorers, by Government surveyors, and even occasionally by military expeditions. Nevertheless, such is the intricate character of the land, consisting of nearly parallel mountain ranges running close together, mainly north and south, separated by deep intervening river gorges, often densely wooded, and inhabited by a multiplicity of semi-independent hill tribes in almost

every stage of social culture, that the broad physical features both of the country and its inhabitants had hitherto been but imperfectly understood, while few of the details had been fully worked out. Hence a rich harvest still awaited our traveller, and the abundant materials collected by him and carefully sifted by his scientific fellow-workers could not fail to prove useful and help to solve some obscure problems in the natural history of the country.

Thus a comparative study of the two Gayal skulls from Chittagong and Arakan enables Dr. Kühn to clear up several questions touching the mutual relations of the gayal (*Bos gaurus*, Colebrooke), the armi or true wild buffalo (*Bubalus indicus*), the gaur (*Bos cæphrons*, Hodgson), and other members of the ox tribe in India and Indo-China. It now appears evident that the gayal or wild ox of Bengal, Assam and Further India does not differ specifically from the gaur of India proper, as George Vasey and others wrongly supposed. "While the wild gayals' skulls show all the features of the gaur, the forms of the tame gayal from the same locality correspond altogether to the normal gayal type as described by its best observer, Hodgson. Room is thus afforded for the surmise that both types characterise, not two distinct species, but forms only of the same species; that consequently gaur and gayal are specifically one, and that the deviations of the latter in its tame form have merely the value of a variation due to domestication."

Of more general interest are the admirable ethnological and anthropological papers of Dr. Grünwedel and Dr. Virchow, whose learned analysis of the data, and especially of the numerous measurements supplied by Dr. Riebeck, throws a flood of light on the many perplexing questions connected with this obscure ethnical domain. Accepting the already-established broad distinction between the Khyoung-thâ or River Tribes, and Toung-thâ, or Hill Tribes (Lowlanders and Highlanders), a distinction which has more than a mere geographical significance, these anthropologists find that, on the whole, the hill tribes are of purer descent, that is, represent the aboriginal element more closely, than the riverain populations. The latter (Maghs, Chakmas, Tounginyas, &c.), have become more intermingled with the Bengalese and other intruders from India, and are characterised by a yellower complexion suggestive of Mongol, or perhaps Malay, affinities. The former (Pankhos, Banjogis, Mros, Kumis, Kukis or Lushais, Shos, Shindus, &c.) are of a darker hue, and seem to approach nearer to the Kolarian aborigines of India. At the same time Dr. Virchow is careful to point out that none of these Hill Tribes lend any support to the theory of an aboriginal Negrito element formerly spread over the whole of India and Indo-China, advocated especially by De Quatrefages and other French ethnologists. "According to unanimous testimony they have all black, long, and smooth, but by no means straight, hair, and, although not athletic, their stature still at once separates them from the dwarfish Andamanese and Negritoes. On the other hand, in further inquiry the question cannot be waived whether the Hill Tribes of Chittagong, perhaps also of Nepal, may not, after all, be somewhat nearly related to the primitive 'black skins' of India. The name Dasyu, or

Dasa, recalls in a remarkable manner the word Dzo, applied both to the Lushais and their speech."

On the whole the Lowlanders appear to be closely related to the Arakanese, and consequently to the Burmese, and are characterised by distinctly Mongolic features. They may, in fact, be regarded as a Mongoloid people, intermediate between the true Mongols of Northern and Central Asia and the Malays of Malacca and the Eastern Archipelago.

This section of the subject is illustrated by very complete tables of measurements, and by as many as twenty-six photographs of Lushais, Pankhos, Maghs, Chakmas, Tipperahs, and other highland and lowland tribes.

Dr. Riebeck's account of his experiences amongst these children of nature is extremely graphic, and all the more entertaining that the arrangement with his collaborateurs enables him to eliminate all dry technicalities and strictly scientific matter. At the time of his visit a famine prevailed amongst the border tribes in the upper Karnaphuli basin, causing an irruption of Lushais and others into British territory. Thanks to this circumstance he was enabled to procure many valuable articles from the half-famished people in exchange for a little rice and spirits. The circumstances connected with these transactions are related with a frankness which almost savours of excessive candour. "The brandy I concocted myself," he tells us, "by diluting spirits of wine with water, and colouring it with burnt sugar, thereby producing a still more alluring drink for their uneducated palate. In return, they not only parted with a large quantity of their implements, but also allowed me to take bodily measurements and submitted to be photographed by my fellow-traveller Rosset. If for brandy I had substituted money, this would have soon found its way into the pockets of the Bengali dealers, who cozened and plundered the natives to the utmost. I may therefore be pardoned if I preferred to tickle the palate of the Lushais with fire-water rather than play into the hands of the blood-sucking usurers."

A tropical thunderstorm, by which he was overtaken in the Ruma district, is described in exceedingly vivid language. "The spectacle which now presented itself was one of the most stupendous imaginable. In a few seconds the firmament became completely overcast; then the welkin towered up, looking in the gleam of the electric flashes like mighty sheaves of flame. The weird effect was heightened by the neighbouring woodlands, which were now all ablaze. For the natives had fired the surrounding bamboo-clad hills in order to clear the land for paddy-fields, and sow their rice in the ashes. Thus was mingled the crackling of the burning and crashing bamboo canes with the roaring thunder aloft, the whole producing a din like that of a neighbouring battlefield."

These passages may also serve as specimens of Prof. Keane's very admirable, faithful, and idiomatic translation. It may be mentioned that the German and English editions, both in folio size and splendidly printed, were issued simultaneously by Messrs. Asher, of Berlin and London. The work forms a sumptuous volume which should find a place in every well-appointed library.

#### THE METEOROLOGY OF BOMBAY

*Magnetical and Meteorological Observations made at the Government Observatory, Bombay, 1883, under the Superintendence of Charles Chambers, F.R.S., Rev. Fr. Drechman, S.J., Ninayek Narayan Nene, and Frederick Chambers. (Bombay, 1884.)*

OF the series of volumes entitled "Bombay Magnetical and Meteorological Observations," the present one of forty pages folio is the twenty-fourth. The observations were begun in 1841, and whether we consider the high class character of the observations themselves, the fulness with which they were made from hour to hour, or the long period over which they extend, they must be regarded as among the very best meteorological records we possess. In the discussion of many of the larger questions of Indian meteorology, such as are from time to time dealt with by the meteorologists of India with so much ability and success, the Bombay observations are simply invaluable; and they are at least of equal importance in the wider questions of the science, and particularly in those cosmical inquiries which have largely engaged the attention of physicists in recent years.

In this report a very satisfactory account is given by Mr. Chambers of the observatory, its position, and surroundings, the instruments in use, and the duties of the various members of the observing staff, all showing that a trustworthiness and an accuracy is secured for the observations which leaves nothing to be desired. Five eye-observations are made every day without exception, at 6 and 10 a.m., and 2, 4, and 10 p.m. In addition to these, continuous registrations are obtained by means of automatic recording instruments, consisting of the magnetographs, the barograph, thermograph, pluviograph, and anemograph, the first four registering photographically and the last mechanically.

From these observations and registrations hourly readings of the various instruments are obtained, and from them the daily means are deduced. These daily means, together with the monthly means, are published in a series of tables appended to the Report. The daily results of the wind observations are given with more than usual fulness,—these consisting of the mean velocity in miles per hour without regard to the direction from which it blew; the aggregate and mean velocities and relative frequency of different winds; and the mean daily velocities of the north or south and east or west components of the winds which blew each day, in miles per hour. At Bombay the greatest mean daily velocity in miles per hour was 31·8 on June 11, and the least 5·2 on October 4; whilst the mean hourly velocity from June to August was 16·2 miles, and from September to May it was only 10·9 miles.

Underground observations are made at depths of 1, 9, 20, 60, and 132 inches below the surface, the first two depths being observed five times daily and the last three once a day, inasmuch as at these depths no diurnal variation is shown. At depths of 1 and 9 inches the monthly maximum and minimum temperatures occurred in December and May, but at the depth of 132 inches these annual phases were delayed till March and July. The mean annual temperature of the air during 1883 was 78°·8,

and of the ground, at a depth of 1 inch, 80°9; 9 inches, 80°7; 20 inches, 82°6; 60 inches, 83°8; and 132 inches, 83°2. It is desirable that the errors of these underground thermometers were ascertained.

Down to the close of 1864 the hourly observations made at Bombay were published *in extenso*, and these twenty-four years' hourly observations furnish data for the prosecution of many inquiries, the value of which it would be difficult to over-estimate. From 1865 to 1872 the individual observations ceased to be published, but the hourly means for the different elements continued to be published. From these the hourly means of pressure, temperature, humidity, cloud, thunderstorms, &c., can be obtained for a period of more than thirty years. From the beginning of 1873, however, no hourly observations, or even hourly means, appear in the reports, want of funds presumably being the cause of the omission. Irrespective altogether of the length of time over which the observations have been made and the immense value this single consideration gives to the Bombay observations, the position of this observatory with respect to the monsoons and other vital elements of the meteorology of India render the maintenance of a first-class meteorological observatory in this part of the empire indispensable. It is in truth simply necessary in the interests of Indian meteorology and its satisfactory development that the Bombay Observatory be kept in a state of high efficiency, and that the individual observations made there be published and distributed among men of science at least as liberally as they were previous to 1865.

#### OUR BOOK SHELF

*Supplement to "Euclid and His Modern Rivals," containing a Notice of Henrici's Geometry, together with Selections from the Reviews.* (London: Macmillan and Co., 1885.)

WE noticed the original work at such length in these columns (*NATURE*, vol. xx. p. 240), that it is not worth while on the present occasion to do more than draw attention to the issue of this "Supplement."

Prof. Henrici's "Congruent Figures" was published nearly contemporaneously with Mr. Dodgson's book, and so he was unable to discuss the methods employed by the Professor, who, in the words of the present preface, "fills the rôle of that popular functionary, dear to Parisian diners, le quatorzième."

The discussion forms scene vi. of Act ii., and is headed "Treatment of Parallels by Revolving Lines," and an extract, as usual, leads the way from Henrici's Art of Dining (so our humourist puts it), viz. "in order that an aggregate of elements may be called a spread, it is necessary that they follow continuously."

It will thus readily appear to the readers of the "Euclid and his Modern Rivals," or of our account referred to above—which by the way is honoured by a partial reproduction amongst the review-selections—that Mr. Dodgson is still himself, and that his hand has lost none of its former cunning. We should have liked him to have given his opinions on other parts of the Professor's book, but it has not seemed good to the author so to act, and he has confined himself mainly, if not entirely, to the Lobatschewky treatment of parallels. With two such combatants now fairly in the arena, we shall be content to act as a mere onlooker whilst the strife wages fiercely between them, eagerly noting the parry and the thrust, and ready, if need be, to use the sponge as this or that combatant is struck.

It might be a mighty pretty encounter—Modern Treatment versus the Euclidian.

Mr. Dodgson inserts remarks here and there in the text of the reprinted criticisms: he does not notice that a complaint he makes against us was in great part apologised for on p. 404 (vol. xx., see above).

*Leitfaden bei zoologisch-zootomischen Präparirübungen.*  
Von A. Mojsisovics Edlen von Mojsvár. 2nd ed.  
(Leipzig, 1885.)

We are glad to welcome a second edition of this work, which is a very useful manual for museum curators and for demonstrators in the rapidly increasing number of zootomical laboratories. Although it appears to be designed for use in high schools we cannot think that it is likely to displace the manuals already in use in this country: it wants the didactic character of Huxley and Martin's "Elementary Biology," the simplicity and directness of Prof. Milnes Marshall's admirable little book on the "Frog" (which is, we are glad to learn, to be soon followed by others), or the detailed directions of Prof. T. J. Parker's "Zootomy." We may note by the way that these works appear to be unknown to our author, whose knowledge, indeed, of English works on anatomy, or, as Messrs. Wilder and Gage call it, anatomical technology, is very incomplete.

So far as German authorities on "Museologie" are concerned, the second edition appears to have been brought up to date; some additions, not always, however, improvements, have been made in the illustrations; some of the English authors whose works are neglected would have provided the author with a better figure of *Astropecten* than the shocking "representation" which is copied from Bronn. When the third edition is called for we hope we shall find the grave, but perhaps the only important, defect which we have noted corrected and accounted for.

#### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

#### On Watering the Coal-Dust in Mines

REFERRING to an explosion that happened at Lievin Colliery in the Pas de Calais on January 14 last, my friend M. Ed. Sauvage, Ingénieur des Mines, writes as follows:—"Some experiments have been lately made at Lievin Colliery (Pas de Calais), where a disastrous accident happened a few months ago. I do not think any report of these experiments has been published; but they found the coal-dust inflammable, and the watering of the ways in the mine has been resorted to as a precaution against future accidents."

Twenty-nine persons were killed by this accident, that is to say, all who were in the mine with the exception of one. The survivor, a miner named Cornet, and one of his comrades, had prepared a blasting-shot for dynamite, and called upon the shot-firer to ignite it. The latter examined the place, pronounced it to be free from fire-damp, and lighted the fuse.

At the inquest Cornet stated that he saw the shot go off, and had just time, by a quick movement, to throw himself under a heap of straw lying near when the explosion took place. He remembered nothing more, and attributed his escape to the partial protection afforded by the straw.

After investigating the case and hearing Cornet's evidence, the Government engineer and those of the Company who owned the mine came to the conclusion that the explosion was caused by the ignition of the coal-dust that had been lying upon the timbers which formed the supports of the gallery. In corroboration of this opinion they pointed out the fact that the current of air which swept through the gallery in which the explosion originated was too swift to admit of firedamp lodging there.

For some years past a system of more or less careful watering has been practised in some of the largest and driest of the steam coal collieries in South Wales as a precaution against explosions—and the recent occurrences at Usworth, Lievin, Camphausen, and Pendlebury seem to show that similar measures are greatly wanted elsewhere.

Should watering the dust (locally in the neighbourhood of blasting-shots, or generally in the workings) ultimately prove to be the panacea for great colliery explosions, then it is obvious that the responsibility for the holocausts that are now occurring lies almost as heavily upon those who, having the power, fail to hasten its adoption, as upon those who continue to offer it a selfish or factious opposition.

W. GALLOWAY

#### The Colours of Arctic and Alpine Animals

I MUCH regret that I have been too busy to reply to my friend, Mr. A. R. Wallace (NATURE, April 16, p. 552), till the present moment, but this delay, unavoidable on my part, is the less to be regretted, since it has given an opportunity for the interesting facts recently adduced by Sig. Lorenzo Camerano (NATURE, May 28, p. 77) to be taken into consideration. As Mr. Wallace, with that keen penetration so familiar to all who know him and his writings, goes to the root of the matter under discussion and raises a distinct issue, I will now beg permission to offer a few words in reply to both these gentlemen.

First, with respect to the physical side of the question, Mr. Wallace is perfectly correct in supposing that colour *per se* has no influence upon the radiating or absorbing powers of bodies as far as regards obscure radiation. But I would point out that in the present case we are not concerned with colour alone; we have not merely to consider whether black or white is the best radiator, but we have for comparison two surfaces, hair or feathers, as the case may be, having, as far as we know at present, the same structure, and differing only in colour. The question before us is whether this colour-difference in the same substance is associated with any difference in radiating or absorbing power, and the final answer can only be given by carefully conducted experiments. I may add that I have long been waiting for an opportunity of conducting the necessary investigation, and with aid that has been kindly offered from several quarters I hope before long to be in a position to arrive at some satisfactory conclusion. The form of experiment suggested by Mr. Wallace, although decidedly worth the trial, does not appear to me to be very safe, inasmuch as the natural structure and arrangement of the fur would be lost in the process of weaving into cloth. Mr. Wallace's strictures as to the use of artificial dyes are, however, quite sound, and in these I fully concur. I may further state that when this question was raised some years ago, I searched literature (although by no means exhaustively) to see whether any experiments had been recorded, and although many hundreds of observations upon the radiative and absorptive powers of different bodies have been made by various physicists from the time of Franklin downwards, I have not been able to find any experiment bearing directly upon the question under consideration.

The point to be decided is, not only whether dark hair or feathers are better radiators than white hair or feathers, but whether the radiative power of these white coverings is less for that particular kind of radiation which is most greedily absorbed by the substance (snow) among which the animals have to pass their winter existence. Till this problem is solved physically we have, as it seems to me, only the purely biological considerations to fall back upon.

Before passing on to the more strictly zoological side of the subject I should like to disclaim the notion to which Sig. Camerano's letter may give rise, that the radiative (as distinguished from the protective) theory of Arctic colouring is original as far as concerns myself. With respect to the white covering of the warm-blooded animals, this theory was, as far as I knew at the time, original when first broached in 1880; but Lord Walsingham afterwards showed that the same conclusion had been arrived at in 1846 by Craven, with whose name it should be more fairly associated. The application of this theory (in a reversed sense) to explain the melanism of Arctic insects is entirely due to Lord Walsingham, and as my friend Mr. Wallace is disposed to give the weight of his authority to this extension of the theory, there is no occasion to discuss this point further on the present occasion.

It now remains to point out some of the considerations which

have led me to the belief that the protective theory of white colouring is not wholly sufficient. Thus, among birds there seems to be a tendency among the falcons (*F. canticans*, *F. islandus*, &c.) to become white in high latitudes—a mode of coloration which does not appear to me to be of much use in such species. These birds, as far as I know, swoop down on their prey from above, under which circumstances the lighter colouring would be of no advantage in enabling them to approach their prey undetected; on the other hand, it can hardly be maintained that these birds are subject to any persecution which would cause their lighter plumage to be of protective value. When on the wing the back only would be seen by another bird hovering over the falcon, and it is noteworthy that this part of the falcons in question is *darker* than the under side. The same considerations apply to the snowy owl (*Nyctea scandiaca*). In many other birds, again, such as the plovers (*Charadrius pluvialis*, *Squatarola cinerea*, &c.) and various species of *Scopacidae* (*Tringa variabilis*, *T. subarquata*, &c.), the under side only changes to white in winter—a change which it is impossible to associate either with protection from foes or with predatory advantage. On the other hand, it seems not unreasonable to suppose (on the radiation theory) that the under side of the bird, being nearest to the snow-covered surface of the ground, would require the most protection. It is of interest also to bear in mind from the present point of view that many mammals are known to become white on the under side during winter. Thus, Surgeon-Major Leith Adams, F.R.S., states in his observations on the natural history of Eastern Canada<sup>1</sup> that "there is, moreover, a seemingly strong disposition for the lower parts of animals to become white in winter—i.e. the parts in closest contact with the snow; thus the under surfaces of the deer tribe are always whitest. And, as if from its habit of constantly digging among the snow with its snout in quest of food, we find the cariboo with a white patch on its lips and around the hoof, &c." Such facts as these cannot, as it appears to me, be explained on the protection theory; but if any connection exists between the mode of colouring of an animal and its external conditions of life, the theory of preventive radiation or even the direct action of low temperature on the formation of the pigment seems to be more applicable.

The objections raised by Signor Camerano, although supported by some interesting observations, are, I venture to think, somewhat wide of the mark. The writer, indeed, endeavours to bring within the scope of the radiation theory classes of facts which I for one should certainly never dream of attributing to this cause, even if it had been demonstrated on a sound experimental basis. There can be no question as to the truth of his concluding statement that the causes tending to modify the colours are of an extremely complex character. It is this very complexity, indeed, which renders it so highly important to thoroughly investigate any explanation which bears the stamp of truth, though perhaps applicable to but a very limited group of facts. In view of these difficulties, and bearing in mind the inexhaustible resources of nature in adapting organisms to their environment by apparently opposite means, it is not at all surprising that cases should exist which stand apparently opposed to the particular class of cases here dealt with. There are many conceivable ways of enabling an animal to struggle against a severe climate besides that of lightening the colour of its fur, and natural selection would take advantage of any and every means presented for securing this end. To say, therefore, that some animals become darker in winter (*Cervus mandarinus*), or that others do not change colour at all (*Rupicapra europea*, *Capra ibex*), is no real objection to the radiation theory, but simply an illustration of the principle that there are many ways of securing the same result. Thus, in the case of the two last-named species, Sig. Camerano himself states that there is a great difference in the thickness of the winter covering. Then, again, the statement that a more or less distinct seasonal change of colour is observable in many animals appears to me to have no precise bearing on the question—all that can be said from the point of view either of adaptation or climatic protection is that in such slight mutations we have given to us a hint as to the method by which the more striking seasonal changes have been brought about. We must regard such changes either as the incipient stages of a seasonal variation which could, if necessary, be worked up into a more perfect adaptation (protective or climatic), or as the vanishing remnants of a seasonal variation formerly important, but now useless. The facts that some animals which are not polar or alpine are *permanently* white, that the

<sup>1</sup> "Field and Forest Rambles," 1873, p. 124.

colours of some Alpine Coleoptera are brighter than those of the warmer plains, and that the species of small islands often show a tendency to melanism, are at present simply inexplicable, but, as far as I can see, do not tell for or against either theory. It would certainly be a strong case against the present view if any animal could be named which became white in winter and was not an inhabitant of a country subject to cold winters. As far as my knowledge extends no such species exists. The light colour of desert mammals is most probably due to predatory advantage—the melanism of desert insects mentioned by Sig. Camerano is, I must confess, a new fact to me, and not at all in accordance with my own limited experience. The strongest objection raised by Sig. Camerano is, perhaps, contained in the statement that in the birds of the Antarctic region black is much more prevalent than in those of the Arctic regions. It is unfortunate, however, that the writer adduces in illustration such countries as Australia and New Zealand, which certainly cannot be considered within the Antarctic region.

In conclusion I should like to emphasize that the theory of climatic protection is not, as Mr. Wallace appears to believe, opposed to the theory of adaptation. If my first letter gave rise to this impression, I will take the present opportunity of pointing out that the animal kingdom abounds with cases of what our German colleagues happily call "functional change" (*Funktionswechsel*)—that is, the conversion of a character (or function) originally acquired for one purpose to a totally new use. It is thus not at all improbable that a mode of coloration originally acquired as a climatic protection, may afterwards be found to be of adaptive value, so that climatic and natural selection would in such cases work together. I fully concede that many of the Arctic and Alpine species now derive such advantages from their white covering; the question is whether this colouring was originally acquired solely for this purpose, or whether climatic adaptation may not have had an equal or even a greater influence in its production.

R. MELDOLA

## Clifford and Professor Tait

MAY a "so-called) Metaphysician"—who has merrily waited to see if some one for whom Prof. Tait could have more respect would anticipate him—venture to remark upon a passage in the review of Clifford's "Exact Sciences" that appeared in NATURE of June 11?

Prof. Tait first calls "awkward" and "unnecessarily puzzling" Clifford's statement that "if we can fill a box with cubes whose height, length and breadth are all equal to one another, the shape of the box will be itself a cube"; and then, declaring with greater emphasis that it "at first sight seems to be nonsense," he adds:—"Read it, however, thus: 'If we can fill with cubes a box whose height, &c. . . . the shape of the box itself will be a cube,' and the absurdity, suggested by the collocation, disappears."

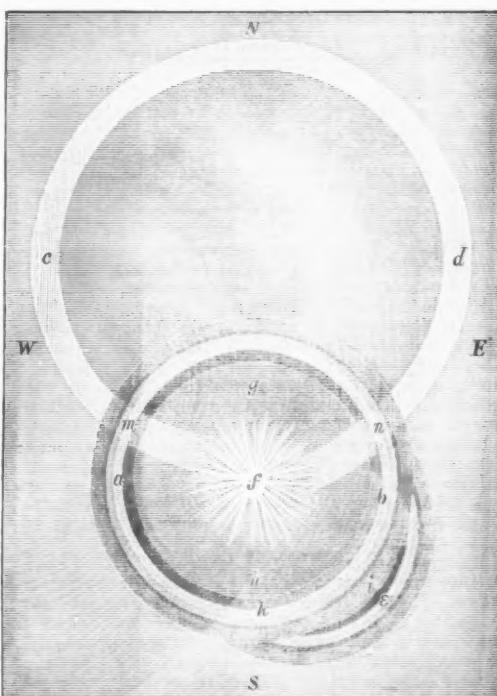
Now Clifford's statement is not sufficiently guarded, being, as it stands, not true of the cube only; but it surely conveys a real meaning, in a "collocation" of words as plain as possible. It is something (whether much or little) to be told that a cube can be made up of a number of equal cubes; especially in view of the context (p. 16). But does Prof. Tait, with his sentence, tell us anything at all, except that a cube is—a cube; or say even that plainly?

R.  
June 22

## Unusual Atmospheric Phenomenon

THE accompanying drawing—a copy of a sketch taken at the time—represents an unusual atmospheric phenomenon witnessed by several friends and myself during a recent visit to Ireland. It occurred on the 6th inst., a bright warm day, with a light breeze blowing from the east. The sky was free from clouds, excepting a few cirrus and cirro-stratus collections on the northern horizon. Engaged at the time in fishing from a boat on one of the Irish loughs, I was conscious of a change in the character of the light reflected from the water and distant objects and looking towards the sun (f), noticed that it was surrounded by an exceedingly brilliant halo (ab) of about 48° diameter, the contained space (gh) being filled with vapour of a dull leaden blue colour, which, by obscuring some of the solar rays, apparently produced the peculiar light effects that first attracted my attention. The time was 1.30 in the afternoon. Calling the attention of my friend, Dr. Simpson, to the pheno-

menon, I recorded the accompanying details. The primary halo (ab) consisted of a brilliant, well-defined band of about 8 width, composed of the spectral colours in the usual sequence, the red ring being nearest the sun. The whole band was most vivid, but the northern half the brightest. At about two o'clock I noticed a bulging (i) of the leaden-coloured vapour of the primary halo (ab) to the extent of 6° or 7°, and in its south-eastern quadrant, and this protrusion, at first only faintly fringed with colour, soon was bounded by a spectral bow (e) at least as vivid as the brightest portion of the primary halo. The adjacent portion of ab, whether by comparison with e or whether because partially obscured by the protrusion of the vapour around which e was formed, I cannot be sure, seemed much paler than the rest of ab. Simultaneously with the formation of this secondary bow a large white ring, represented in the drawing by cd, slowly formed around a centre to the north of the sun, and rapidly assumed a well-defined contour. Its diameter was 72°. Had it been complete it would in its southern portion have passed through the sun, but after cutting the primary halo (ab) at the points (m and n),



which it rendered more faint, it gradually disappeared before reaching the sun. This latter ring (cd) began to disappear about a quarter of an hour after I first noticed it, its north-western portion fading first. I noticed no mock-suns at the points of contact of either of the eccentric rings, and was, unfortunately, unprovided with my small pocket polariscope, and therefore unable to ascertain how much of the phenomenon was due to double refraction. The portion (e) may have been thus produced, but it certainly appeared, as drawn, to be a portion of a ring of smaller radius than (ab). The Rev. T. G. Beaumont, who also observed this spectacle, states that he saw the primary halo (ab) gradually start from a much smaller ring around the sun. The accompanying drawing, though rough, is as accurate as compatible with the absence of measuring instruments.

ALEX. HODGKINSON

26, King Street, Manchester, June 16

## Sky-Glows

Your correspondent of Clairvaux-sur-Aube says (NATURE, vol. xxxii. p. 147) the sky-gloves are again visible in France. I

can corroborate the fact as regards the valley of Lake Leman, in Switzerland. At Geneva, a newspaper has described the abnormal crepuscular glows of June 2, 3, 4, and 13. At Morges (46° 30' N. lat.), Prof. C. H. Dufour and myself have observed them on the 12th and 13th.

On the 12th the sun disappeared beyond the Jura range about 7h. 30m. p.m.; at 8h. 10m. my attention was called by the brilliant illumination of a strange pale yellow, the same which in December, 1883, and January, 1884, always foretold the great crepuscular glows; at 9h. the western sky was coloured by brilliant purple red tints, which spread as high as the zenith; the red colour only vanished from the horizon at 9h. 30m.—i.e. two full hours after sunset. The successive phases of the phenomenon were the same as in the winter 1883-1884; the brilliancy of the colours was, however, fainter, but they were, perhaps, of greater duration.

On the 13th the same glows were observed, with decreasing intensity; on the following days nothing extraordinary has been noticed.

F. A. FOREL

Morges, Switzerland, June 21

#### THE INTERNATIONAL EXHIBITION—MUSIC LOAN COLLECTION<sup>1</sup>

THE story runs that a countryman, visiting London for the first time, and feeling bound to see Westminster Abbey, by a slight mistake overlooked the Royal Fane, and attended service in St. Margaret's Church hard by. He told his friends in the shires on coming home that the ancient edifice was sadly overrated. Exactly a parallel case to this has just occurred to the writer of the present lines. He was informed by an unknown friend that the small collection of unlabelled instruments in the basement of the Albert Hall was unworthy of the occasion; and he only made out on close inquiry that the person in question was speaking of one out of the two "overflow rooms" in which the superabundant stores of the Loan Collection are housed, and had never seen the Loan Collection itself at all. This was the more remarkable as the said individual carried the proof-sheets of his guide-book to the Inventories which he was in the act of sending to the printers. It is therefore clearly not superfluous to state that this, probably the grandest and most complete illustration of the history, progress, and development of music ever furnished, occupies the whole of the circular gallery which forms the top storey of Capt. Fowke's gigantic building, and runs over into two large rooms at a lower level.

It is impossible in a short preliminary notice to do more than call early attention to the vast mass of priceless materials here collected, and soon to be again dispersed; nor can sufficient credit be accorded to Mr. Alfred Maskell, who, aided by his learned father, has been mainly instrumental in arranging and bringing it into order. He has been seconded signal by Mr. Hipkins, representing the old and honoured firm of Broadwood and Sons, so that the collection of ancient spinets, virginals, clavichords, harpsichords, and the like is the most remarkable ever brought together. There is at least one such instrument lent by its noble owner from his family seat in Ireland which is all but unknown even to connoisseurs.

The Belgian Government have most liberally lent the whole of the grand museum of the Brussels Conservatoire of Music, originally presented to that institution by M. Victor Mahillon. This in itself is a "Syntagma Musicum," like the scarce work of Praetorius, but presenting the very things themselves, not merely their graven images.

The realism of the exhibit is carried to the highest degree by three beautiful model rooms, designed with the taste and accuracy for which Mr. Davidson, himself an exhibitor of some grand fiddles, is so justly noted, each room showing furniture, decoration, and instruments of a

great epoch in musical history. The visitor can, if he choose, yield to the pleasant illusion and revel in the madrigals of Orlando di Lasso, "*Il più dolce cigno d'Italia*," the motets of the Elizabethan age, the Lulli-inspired melodies of Purcell; or sit at the clavichord with Handel and grand old John Sebastian Bach. Of its kind the thing is as nearly perfect as can be, and the undersigned takes the first possible opportunity of praying his brother and sister amateurs not to let slip the unique privilege of seeing it.

W. H. STONE

#### THE MEASURE OF FIDGET

ATTERLY—no matter where—I was present at a crowded and expectant meeting. The communication proved tedious, and I could not hear much of it, so from my position at the back of the platform I studied the expressions and gestures of the bored audience.

The feature that an instantaneous photograph, taken at any moment, would have most prominently displayed was the unequal horizontal interspace between head and head. When the audience is intent each person forgets his muscular weariness and skin discomfort, and he holds himself rigidly in the best position for seeing and hearing. As this is practically identical for persons who sit side by side, their bodies are parallel, and again, as they sit at much the same distances apart, their heads are correspondingly equidistant. But when the audience is bored the several individuals cease to forget themselves and they begin to pay much attention to the discomforts attendant on sitting long in the same position. They sway from side to side, each in his own way, and the intervals between their faces, which lie at the free end of the radius formed by their bodies, with their seat as the centre of rotation varies greatly. I endeavoured to give numerical expression for this variability of distance, but for the present have failed. I was, however, perfectly successful in respect to another sign of mutiny against constraint, inasmuch as I found myself able to estimate the frequency of fidget with much precision. It happened that the hall was semicircularly disposed and that small columns under the gallery were convenient as points of reference. From where I sat, 50 persons were included in each sector of which my eye formed the apex and any adjacent pair of columns the boundaries. I watched most of these sections in turn, some of them repeatedly, and counted the number of distinct movements among the persons they severally contained. It was curiously uniform, and about 45 per minute. As the sectors were rather too long for the eye to surely cover at a glance, I undoubtedly missed some movements on every occasion. Partly on this account and partly for the convenience of using round numbers I will accept 50 movements per minute among 50 persons, or an average of 1 movement per minute in each person, as nearly representing the true state of the case. The audience was mostly elderly; the young would have been more mobile. Circumstances now and then occurred that roused the audience to temporary attention, and the effect was twofold. First, the frequency of fidget diminished rather more than half; second, the amplitude and period of each movement were notably reduced. The swayings of head, trunk, and arms had before been wide and sluggish, and when rolling from side to side the individuals seemed to "yaw"; that is to say, they lingered in extreme positions. Whenever they became intent this peculiarity disappeared, and they performed their fidgets smartly. Let me suggest to observant philosophers when the meetings they attend may prove dull, to occupy themselves in estimating the frequency, amplitude, and duration of the fidgets of their fellow-sufferers. They must do so during periods both of intentness and of indifference, so as to eliminate what may be styled "natural fidget," and then I think they may acquire the new art of

<sup>1</sup> We hope to supplement this preliminary note by a more detailed notice of the collection when it is complete and the Catalogue ready.—ED.

giving numerical expression to the amount of boredom expressed by the audience generally during the reading of any particular memoir.

F. G.

#### RECENT EARTHQUAKES

THE shocks of earthquake in Cashmere continue with unabated violence and even appear to increase in frequency and force. Three severe shocks occurred during the night of the 13th and a smart convulsion on the morning of the 14th. It is now ascertained that 221 lives were lost in the Muzafferabad district, where at first it was thought there had been no casualties. The earthquake was also felt in Gilgit. Another very severe shock at Baramulla on the 17th demolished all the buildings which escaped former shocks. At Skardo on the 14th and at Srinugur on the 17th, 18th, and 19th, shocks were felt. In the Kamraj district the loss of life exceeds 2700. The Jhelum Valley, from Srinugur to Dopatta, appears to have suffered most. It is stated that both sides of the river from Sopur to Baramula have been seared with cracks, as also the low alluvial hills in the vicinity. The available data fix the centre of the disturbance in the vicinity of Gurais. It thus appears that in extent and amount of destruction the Cashmere earthquake must rank amongst the great seismic catastrophes of the century.

On Thursday morning last (June 18) a portion of Yorkshire was visited by an earthquake shock. The reports from outlying districts show that the shock extended from the east coast through the Wolds and westwards as far as Headingley, near Leeds. Signalmen on the North-Eastern Railway speak positively as to the vibration and noise. Crockery and glass rattled on the shelves of houses, and at Knottingley and Ferrybridge persons ran from their houses from fear. At Easingwold desks and tables were seen to move, and there was a rumbling noise as of thunder. In some cases there was a severe shaking of houses, and doors were moved. The various reports concur as to the time being 10.50, and it is said there were two shocks. It is a curious coincidence that about an hour previous to this on the same day and in the same region the frightful explosion at the Clifton Hall Colliery took place. Unhappily our knowledge will not permit us to connect seismic disturbances with disasters or mishaps in mines, but we have here a violent and unusual disturbance in the crust of the earth in Yorkshire and an almost simultaneous mining catastrophe in Lancashire.

We have received the following communications with reference to the Yorkshire earthquakes :—

A SLIGHT shock of earthquake was felt here yesterday morning in the favourable stillness of the "Friends" meeting for worship. The time was observed to be about 10.47 a.m. I was seated with my back to the north, when a rumbling sound appeared to be swelling onwards for about two seconds from the south or south-west. I then noticed that the hanging leaf of a small table in front of me (its plane lying east and west) was rattling very distinctly, and immediately I became aware that the back of my seat was shaking me perceptibly. Others heard some of the windows rattling on both the east and west sides of the house, and were shaken by their seats moving slightly; these seats were some of them at right angles to mine. Some of these persons thought the rumbling came from the east; others from the west. One gentleman, sitting in a corner, thought that his right shoulder, against a north partition, was shaken more than his left, against the east wall. He also thought that the rumbling came from the south end of the house. The place of worship is about two-thirds of a mile to the north-east of our observatory, which is in lat.  $53^{\circ} 38' 40''$  N, and long.  $1^{\circ} 20' 32''$  W. Nothing was noticed at the time by a man and a boy working in our garden. It is reported in

to-day's *Leeds Mercury* to have been felt at York, Leeds, and Driffield.

WILLIAM SCARNELL LEAN  
Flounders College, Ackworth, near Pontefract, June 19

CAPT. STAVELEY, at whose house the recent earthquake of June 18 was felt in a marked degree, gives me the following information respecting it. His house at North Dalton (seven miles south-west of Driffield) stands on a slight elevation surrounded with undulating hills common to the Cretaceous formation of the Wolds. The shock occurred between 10.30 and 10.45 a.m. (the exact time was not noted), and lasted about three seconds, travelling from west-south-west to east-north-east. Mrs. Staveley, who was in her bedroom at the time, felt a slight shock, then a rumbling sound as of thunder, and after that another stronger shock. The servants downstairs felt a distinct rocking, and the bricklayer's boy, on a ladder level with the roof, saw the whole roof heave up and down three times. In the dairy some dishes firmly placed on a high shelf were thrown down and broken, and at the inn on the other side of the road the walls trembled perceptibly, and the bottles and glasses were shaken and knocked against each other. The inhabitants of this and neighbouring villages felt the vibrations more or less distinctly, but the shock seems to have been greatest at, and in the direction of, Capt. Staveley's house. The colliery explosion near Manchester happened about an hour earlier; is it possible for there to be any connection between the two?

J. LOVELL

Driffield

The following extracts are from the *Hull Express* of June 20 :—

Information which reached us yesterday shows that the earthquake-shocks experienced on Thursday in York and Market Weighton were also felt in more or less degree in other parts of the great shire.

Mr. W. Botterill, of Parliament Street, Hull, writes :— "On returning home (Newland Park) from business last evening, my wife informed me that during the morning she had for some seconds very sensibly felt a vibratory motion in the house, which she fully believed to be caused by a slight shock of earthquake, and added that she should confidently expect to find in this morning's papers notices in confirmation thereof. It was, therefore, no surprise to learn from your current issue, and other papers of to-day, that similar effects had been experienced at York, Market Weighton, and elsewhere, about the same hour of the day."

A North Cave correspondent says that at about eleven o'clock in the morning nearly every house was subjected to a slight shaking.

A Driffield correspondent says that at the village of Hutton several residents felt a severe shaking of their houses, and at the same time the inner doors were suddenly moved, crockery upset, and other signs of disturbance were observed. People were so terrified that they cannot very accurately describe the shock, but state they felt a "reeling" sensation.

Another correspondent writing from Driffield says :— "Yesterday morning a somewhat severe shock of earthquake was felt at North Dalton, a village about eight miles from Driffield. The shock appears to have been the most distinctly felt at the residence of Capt. Staveley, which stands in an isolated and elevated position, and the house vibrated from basement to roof for several seconds. A bricklayer's apprentice who was repairing the roof had a narrow escape of being thrown down, and the greatest alarm was felt by the villagers, who 'ran out of their houses in fear for their lives.'"

The shock was also distinctly felt in Leeds. In Delph Lane, Wood-house Ridge, the occupants of three houses which adjoin each other noticed it. It resembled the effect which would be produced by the violent shutting of doors, the windows rattling, and there being a perceptible

vibration of the buildings. The same tremulous motion was also felt in Victoria Road, Headingley, and no doubt in other parts of the town.

At Snaith and neighbourhood similar effects were produced. Mr. Barrett, the postmaster of that town, says the shock was so severe as to cause quite a noise with the goods on the shelves in his shop window vibrating, and he felt the floor under him shake distinctly. At 10:48 a.m. on Thursday morning an earthquake was distinctly felt at Thorne, Hatfield, Epworth, and Eastoft. At various parts of Thorne crockery and glass rattled upon the shelves in the houses, furniture was shifted, and many of the inhabitants were greatly alarmed by the floors slightly descending. At Hatfield Levels also some consternation was caused by the earthquake, which was felt very perceptibly. We have not heard of any damage being done by the shock.

About one o'clock on the morning of the 18th, north-western Argyleshire was visited by an earthquake. The shock was distinctly felt at Ballachulish, and in many of the houses in the slate quarry district of Glencoe. The shock was felt with distinctness in Clachaig Inn, at the top of Glencoe. It travelled in a south-eastern direction.

Dr. Forel, of Morges, writes that a pretty strong shock was felt on the morning of June 20, at 5:16, in the cantons of Neuchâtel, Vaud, Berne, Fribourg, and Geneva, the seismic centre being probably the neighbourhood of the Lake of Neuchâtel. The intensity was No. IV. of the scale of seismic intensity.

#### THE SCOTTISH MARINE STATION

THE equipment of the Research Station at Granton, Edinburgh, has now been increased by the construction of a system of large tanks provided with a constant circulation of sea-water. These tanks are arranged very nearly according to the plan described in the account of the station and its work which was published in April last. The aquarium itself occupies the ground-floor of the building, whose upper story forms the biological laboratory, and it consists of seven large tanks, five of which are shallow, and two deep, the latter being provided with glass fronts. The pump, which is driven by a steam-engine, the high-level reservoir, and the low-level reservoirs are situated at other parts of the premises. One of the deep tanks is being used for the study of the still mysterious life-history of *Myxine glutinosa*. Last week nearly 150 specimens of that animal were brought alive to the station from the neighbourhood of St. Abb's Head, where it is very abundant. These were successfully domiciled in the aquarium. As out of three specimens brought alive to the "Ark" (the floating laboratory belonging to the station) on May 1, and kept in a small glass aquarium about 15 inches long and 9 inches broad, two are still alive and healthy, there is good reason to hope that there will be no difficulty in keeping a large number alive for any length of time in a tank about 7 feet by 5 feet by 4 feet, which are the dimensions of the one now used for the purpose. It was found in the former experiment that the Myxine when left to themselves, burrowed into the layer of mud which had been placed at the bottom of the small aquarium, and lay for hours motionless, their bodies, with the exception of the extreme tip of the snout, being entirely buried. The snout is protruded for the purpose of respiration, a current of water passing constantly through the nostril into the oesophagus, and escaping at the two respiratory apertures. The normal condition of the animal when not actively engaged in the search for food is evidently to lie thus buried in mud. It is well known to fishermen, at least to those who are employed in line-fishing, that eels, as Myxine are called by them, are met with almost exclusively on muddy ground. At the place where the creatures are more abundant than anywhere else in the neighbourhood of the Firth of Forth, namely,

off St. Abb's Head, the sea-bottom throughout an extensive area consists of soft black mud. A quantity of this mud was brought to the station with the living specimens, and a layer of it 6 or 8 inches in depth placed at the bottom of the tank in which the Myxine were to be kept. The animals are now thickly scattered through the layer of mud, like earthworms in garden soil.

Some of the shallow tanks are being used for the study of the reproduction of the oyster. Supplies of oysters are being obtained from various sources, and before long a series of experiments as to the conditions necessary to the life of the oyster larvæ will be carried out. It is hoped, as the least result from this work, that new interest will be aroused in this country in the question of the scientific artificial cultivation of oysters.

The opportunities afforded for research by the laboratory and new aquarium cannot be fully utilised by those now working at the Station, and biologists who would come and carry out original work at the Station would be gladly welcomed.

A temporary branch of the station is now being organised at Millport, on the Firth of Clyde. It will be open during the months of July and August. The floating laboratory known as the "Ark" will be moored next week in still water off one of the small islands in the Bay of Millport, and the yacht *Medusa* will be stationed there for the purpose of dredging and providing material for study. Several naturalists have made arrangements to carry on work at Millport during part or whole of the time that the "Ark" will be there: amongst others the Rev. A. M. Norman, Prof. W. A. Herdman, of University College, Liverpool, Mr. David Robertson, of Glasgow; Mr. J. Harvey Gibson, Mr. J. R. Henderson. Mr. John Murray, convener of the Committee, entrusted with the management of the Scottish Marine Station, will be at Millport during the greater part of the time. It is hoped that one result of the work will be the preparation of an account of the fauna of the Firth of Clyde which will include, besides the results of the investigations to be carried on, the results of the previous work in the same field. As several of the experienced naturalists mentioned above are already familiar with the fauna of the Firth, a publication on the subject produced by their cooperation will be complete and authoritative. Any naturalists who may wish to carry on research at the Millport temporary station are invited to communicate with Mr. John Murray.

J. T. CUNNINGHAM

#### COMPOSITE PORTRAITS OF MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES<sup>1</sup>

THOSE of the members who were present at the Washington meeting of the Academy last spring will remember that, at the request of Prof. Brewer and myself, they sat for their separate photographed portraits for the purpose of obtaining an experimental composite picture. Prof. Baird kindly offered the facilities of the photographic department; and the pictures taken by Mr. Smilie, the photographer in charge, bear the same stamp of excellence that characterises so generally the work of that department of the National Museum.

As only one or two previous attempts, I believe, have been made to produce composites in this country, I will state briefly what they are, and how they are made.

The idea in its broadest sense was conceived and applied by Francis Galton for the purpose of obtaining an average or type portrait—i.e. a picture that should show the features that are common to a group of individuals, and exclude those that are purely individual. It is clear that, in proportion as this result is attainable, the method will be of value in obtaining a clear conception of the external characteristics of any given type or class.

<sup>1</sup> From *Science*, to the editor of which we are also indebted for the use of the photographic plate accompanying the article.



FIG. 1.—TWELVE MATHEMATICIANS.



FIG. 2.—SIXTEEN NATURALISTS.



FIG. 3.—THIRTY-ONE ACADEMICIANS.



FIG. 4.—TWENTY-SIX FIELD-GEOLOGISTS, TOPOGRAPHERS, ETC.

COMPOSITE PORTRAITS OF AMERICAN SCIENTIFIC MEN.

*4. The following table gives the estimated value of the*

Galton reminds us that, during the first days of a traveller's meeting with a very different race, he finds it impossible to distinguish one from another, without making a special effort to do so : to him the whole race looks alike, excepting distinctions of age and sex. The reason of this is that, by short contacts with many individuals, he receives upon his retina, and has recorded upon his memory, a composite picture emphasizing only what is common to the race, and omitting the individualities. This also explains the common fact that resemblances among members of a family are more patent to strangers than to the relatives.

The individuals entering into these composites were all photographed in the same position. Two points were marked on the ground glass of the camera ; and the instrument was moved at each sitting to make the eyes of the sitter exactly coincident with these points. The composites were made by my assistant, Mr. B. T. Putnam, who introduced the negatives successively into an apparatus carefully constructed by himself, and essentially like that designed by Mr. Galton, where they were photographed by transmitted light. The arrangements of the conditions of light, &c., were such that an aggregate exposure of sixty-two seconds would be sufficient to take a good picture. What was wanted, however, was not an impression of one portrait on the plate, but of all the thirty-one ; and to do this required that the aggregate exposure of all the thirty-one should be sixty-two seconds, or only two seconds for each. Now, an exposure of two seconds is, under the adopted conditions, too short to produce a perceptible effect. It results from this, that only those features or lines that are common to all are perfectly given, and that what is common to a small number is only faintly given, while individualities are imperceptible. The greater the physical resemblances among the individuals, the better will be the composites. A composite of a family or of near relatives, where there is an underlying sameness of features, gives a very sharp and individual-looking picture.

It would be difficult to find thirty-one intelligent men more diverse among themselves as regards facial likeness than the academicians entering into this composite. They are a group selected as a type of the higher American intelligence in the field of abstract science, all but one or two being of American birth, and nearly all being of American ancestry for several generations. The faces give to me an idea of perfect equilibrium, of marked intelligence, and, what must be inseparable from the latter in a scientific investigator, of imaginativeness. The expression of absolute repose is doubtless due to the complete neutrality of the portraits.

Fig. 3 contains eighteen naturalists and thirteen mathematicians, whose average age is about 52 years. Fig. 1 contains twelve mathematicians, including both astronomers and physicists, whose average age is about 51½ years. Fig. 2 is a composite of sixteen naturalists, including seven biologists, three chemists, and six geologists, with an average age of about 52½ years.

I may mention, as perhaps only a remarkable coincidence, that the positives of the mathematicians, and also of the thirty-one academicians, suggested to me at once forcibly the face of a member of the Academy who belongs to a family of mathematicians, but who happened not to be among the sitters for the composite. In the prints this resemblance is less strong, but in these it was observed quite independently by many members of the Academy. So, also, in the positive of the naturalists, the face suggested, also quite independently to myself and many others, was that of a very eminent naturalist, deceased several years before the sitting for this composite.

There is given also a composite (Fig. 4) of a differently selected group. It is of twenty-six members of the Corps of the Northern Transcontinental Survey—an organisa-

tion of which I had charge, and the object of which was an economic survey of the North-Western Territories. It was a corps of men carefully selected as thoroughly trained in their respective departments of applied geology, topography, and chemistry, and having the physique and energy, as well as intelligence, needed to execute such a task in face of many obstacles. The average age of this group was 30 years.

RAPHAEL PUMPELLY

#### HOW THE NORTH-NORWAY FJORDS WERE MADE

**I**N NATURE (vol. xxx. p. 202) there was published an article by me "On Northern Norway under the Glacial Age," in which, among other subjects, I referred to the course of the travelled granite blocks in the neighbourhood of Tromsö. The researches I had then made in this direction were, however, confined to a limited area, whilst last summer I was able to extend the same to the point whence the blocks started. Although one of my assumptions in the former article has not been confirmed by my last researches, the conclusions I then arrived at have in the main been corroborated. And as I believe that this subject is one of considerable importance to science, I venture to give an account of my last researches.

In order to understand the subject, it is necessary to explain the orographical conditions along the course of the travelled blocks from the Swedish frontier to the Arctic Ocean.

From the eastern end of the Alt Lake, near the Swedish frontier, and northwards to the Store Rosta Lake, the country on the Norwegian side assumes the form of an extensive alpine plateau, with broad depressions, the average height of which is about 2000 feet, running between low rounded ridges. In the south-eastern part of these plateaux, not far from the eastern end of the Alt Lake, the Divi River rises. Having for some 10 geographical English miles followed the plateau, this river flows gradually towards the Divi Valley, which it enters and follows throughout its whole course in a north-easterly direction, flowing eventually into the Maals River at a height of 260 feet (82 m.) above sea-level. Its length, from where it leaves the plateau, to the spot where it joins the Maals River, is about 30 geographical miles. In its upper course, where the Maals River receives the Divi River, the former flows through a wide plain or low plateau, the so-called Överbygd, which gradually slopes down to a distinct valley, the Maals Valley proper, which runs in a westerly direction along the southern slope of the high, island-shaped mountain ridge called Mauken. The latter begins about 5 miles west of the spot where the Divi River enters the Maals River, whence it runs in a direction east-west for a length of about 15 geographical miles, the highest tops being upwards of 4000 feet (1255 m.). On the north-western side, however, the Överbygd gradually rises towards the broad mountain depression filled by the Tag Lake, 7 miles in length, which runs in a direction east-west along the northern slope of Mauken, viz. between the latter and the more northerly-lying ridge Omasvarre, which, with tops upwards of 1900 feet (590 m.) in height, also runs in a direction east-west. The bottom of this depression is filled with the imposing Tag Lake, which lies on a height of about 600 to 700 feet (188 to 220 m.) above sea-level, and thus about 400 feet (120 m.) *higher* than the Divi River at the spot where it enters the Maals River. At the western end of the Tag Lake this depression takes the form of a broad mountain basin, the so-called Tag Valley, which in a north-easterly direction descends to Balsfjord. The distance between the Tag Lake and the Balsfjord is about 10 geographical miles. The Tag Valley is, on the western side, bordered by the lofty Maartin peaks, and further to the north-east by the Slet

Mountain, which, like an arm of the Maartin peaks, gradually slopes down to the Balsfjord.

The line of depression from the spot by the frontier where the Divi River rises, to the bottom of the Balsfjord which we have thus followed, is about 50 geographical miles in length. The course of the Balsfjord is north-westerly, but very crooked, between mountains upwards of 4000 feet (1255 m.) in height. The latter are, however, not continuous, but separated into island-like parts by deep depressions, which, in a recent geological period, when the level of the sea was 300 to 400 feet (91 to 126 m.) higher than at present, must have been submerged, thus making each part an island. In spite, therefore, of the typical fjord character of the Balsfjord, it was originally only a number of sounds, by which it was once connected with the Malangen Fjord on the western, and the Sörfjord, Ulfsvfjord, and Lygenfjord on the eastern side. This is a circumstance of great orographical importance, and which deserves every attention, particularly because it does not apply to the Balsfjord alone, but is a characteristic of the formation of every fjord in the north of Norway from Salten (Bodø) in the south to Lyngen in the north—*i.e.* from 67° to 70° N. lat.

From the bottom to the mouth, in a sound between the mainland and the south-eastern side of the great island, Kvalö, the length of the Balsfjord is about 30 miles. At the Troms Island, which lies about five miles to the north of the mouth of the Balsfjord, this sound is divided into two narrow sounds, about five miles long, on each side of the Troms Island. From the northern point of this island these sounds reunite, and the sound becomes the broad Gröt Sound on one side, which, running in a north-easterly direction, joins the Ulfsvfjord at its mouth by the Fugle Sound—a broad arm of the sea cutting into the land. On the other side, the sound is also connected with the open sea by the Kval Sound, 10 to 15 miles long, which runs in a westerly direction, between the two great islands Kvalö and Ringvadsö. The length from the mouth of the Balsfjord to the end of the Kval Sound by the ocean is about 30 miles, or about the same as the length to the end of the Gröt Sound. Thus, from the bottom of the Balsfjord to the sea the distance described is about 60 miles.

As regards the depth of the Balsfjord and the adjacent sounds, it may be mentioned that that of the former varies from 80 to 100 fathoms (480 to 600 feet = 151 to 188 metres), but from the mouth of the fjord towards the Troms Island the depth steadily decreases, being, in the sounds on both sides of it, not more than 20 to 30 fathoms (120 to 180 feet = 38 to 56 m.). To the north of this island, in the Gröt Sound, on the other hand, the depth increases to 100 or 120 fathoms. In the eastern half of the Kval Sound the depth is from 20 to 30 fathoms, while in the western half it reaches, at the mouth, 120 fathoms. It will therefore be seen that the depth of this channel in the main increases seawards, if we except the two places by the Troms Island and in the Kval Sound, the shallowness of which may be caused by narrowness of the sounds, and the consequent opportunity for the deposit of marine débris.

Thus, the entire length of the line of depression we have examined from the sources of the Divi River to the ocean is 96 geographical miles, while the bottom of the same falls from 2000 feet above the level of the sea to 720 feet below it—*i.e.* a total fall of 2720 feet.

The geological structure of the mountains here is very remarkable. A large mass of granite which appears at each end extends inland far into Sweden, and, on the Norwegian side, reaches the upper Divi Valley. The rock is composed of orthoclase, microlin, plagioclase, a great deal of quartz, but very little mica. The colour is reddish, the structure granulated. At the other end of the line we have followed, on the Kvalö and Ringvadsö Islands, there are several masses of a grayish, streaky

gneiss-granite, rich in mica, closely allied to the gneiss-masses found here. Petrographically, the Divi Valley and the coast granites are so different, that it seems at first sight very easy to distinguish them, but this is not so easy with the variations of the two kinds.

The mountains which project into these granite-masses are built of layers of crystalline slate, and travelled blocks of this material may be found everywhere; but as it would be a matter of great difficulty to refer these to their original birthplace, I shall not take them into account here. We will, therefore, only follow the course of the granite blocks travelling from the Swedish frontier to the coast.

There are two roads by which they might have moved, viz., one from the southern part of the granite-mass along the Alt Lake to Bardö, and so on; the other more northerly, along the Divi Valley. It is the latter which I intend to discuss here.

The above-mentioned alpine plateaux are strewn with travelled granite blocks, and that the same have travelled westwards from the granite masses by the frontier cannot be doubted. The same applies to all the blocks strewn along the Divi Valley. At the spot where the Divi River joins the Maals River the travelled blocks have followed two courses—viz. one through the Maals Valley, along the mountain Mauken—which we shall not follow—and the other in a north-westerly direction across the Överbygd to the Tag Lake, the lower parts of the Överbygd being thickly strewn with granite blocks which, judging by their petrographical composition, I am sure belong to the Divi Valley granite. Hence the course of the blocks can be traced along the depression in the mountain by the Tag Lake, not only at the bottom, but high up on the mountain sides. Thus, the northern slope of the Mauken is everywhere, up to a height of 2500 feet (784 m.), strewn with travelled granite blocks; indeed the brink of every terrace looks—seen from below—as if it were faced with travelled blocks, which everywhere seem to belong to the Divi Valley granite. Travelled granite blocks were found, too, strewn up the slopes of the Omasvarre Mountain to a height of 1200 feet (376 m.)—viz. as far as I was able to carry my researches. I believe they would be found right up to the top.

From the western end of the Tag Lake the blocks have moved along the Sag Valley, and then to the bottom of the Balsfjord. The flat stretch of shore, 210 feet broad, high, and covered with loose débris, is strewn with blocks which without doubt belong to the Divi Valley granite.

From what I have thus explained we may safely assume that an enormous mass of inland ice has once moved from the frontier through the above-described channels, down to the Balsfjord, and that it must, along the Mauken, a distance of 10 miles from the fjord, still have maintained a height of at least 2500 feet (784 m.) above the then sea-level.

Before we follow the course of the blocks further, I will refer to certain circumstances connected with it thus far. About five miles to the westward of the mountain plateau near the frontier rises the isolated mountain Store Jerta to a height of 4500 feet (471 m.)—viz. about 1000 feet (314 m.) higher than any of the surrounding mountains. The Store Jerta is throughout built of hard crystalline slate. On the very summit of this peak I found a large block of granite which I feel confident is a travelled block from the granite mass to the east of it. Its birthplace must in that case have been at least 1000 feet (314 m.) lower, and, as the Store Jerta has been situated right in the track of the ice-stream from the east, I am of the opinion that the ice has been screwed up here to a very great height; but I confess it seems hardly possible to understand that it could be to such an enormous height.

I have stated above that the Tag Lake lies 42 feet higher than the spot where the Divi River enters the

Maals River, and supposing that this was also the case during the Glacial age the ice-stream must have moved up an incline before it could reach the depression leading down to the Balsfjord. This cannot, however, have been the case. As long as the ice-stream had perfect liberty to travel *down* an incline—here present in the shape of the broad Maals River, along the southern slope of the Mauken—it would hardly ever move in the opposite direction *up* an incline, leaving, however, local accumulations out of consideration. It might therefore be reasonable to suppose that the configuration of the land along the Divi Valley, and especially the Överbygd, was very different during the Glacial age. A continuous, though slightly inclining, surface must under these circumstances at that period have extended from the alpine plateaux above the Divi Valley to the depression along the Tag Lake, and the present configuration be caused by subsequent erosion. It should be stated that the outlet of this lake does not now follow the course of the ice-stream towards the Balsfjord—which might have been reasonably assumed—but is at the opposite, eastern, end towards the Maals River. This seems to indicate that the present declivity of the Överbygd in an easterly direction in any case cannot be older than the close of the Glacial age.

As stated, travelled granite blocks from the Divi Valley are found in great numbers along the northern slope of the Mauken, towards the Tag Lake, upwards of 2500 feet (784 m.); but that these should have been raised from lower levels to their present height seems improbable. The northern slope of this mountain does not lie transversely to the course of the ice-stream, but longitudinally to it. Of course the screwing-up of the ice may also take place in the latter case, but I should say only in isolated spots; this cannot have been the case along the Mauken. Neither is it possible that the bottom of the lake lay at that level in the Glacial age. It must then have lain lower than the alpine plateaux by the frontier, and even if we allow for enormous glacial erosions, it would be impossible to believe that the bottom then lay at such a height. As the blocks on the Mauken cannot thus have been deposited along the bottom of the ice-stream, nor brought thither through screwing-up of the ice, we must assume that they have been deposited from the surface of the ice-stream. The latter being strewn with blocks, which at the frontier was above 3000 feet (941 m.) high, has therefore, at 40 or 50 miles therefrom, had a height of 2500 feet. The surface can, therefore, under this long journey, only have had a very small declivity outwards.

From the western end of the Tag Lake the great ice-stream has moved forward to the Sag Valley, which, being then as it is at present, has been able to receive it and turn it in a north-westerly direction downwards towards the Balsfjord. That the Sag Valley cannot be of glacial origin, produced by erosion, is clear from the very nearly acute angle it forms with the Tag Lake depression. It might also be assumed that the ice-stream here might have moved forward across the Slet Mountain and the long, narrow peninsula between the Malangen and Balsfjord, but that this was not the case is proved clearly by the circumstance that travelled granite blocks are found on this peninsula, or only at low levels, which I shall presently explain.

It may be probable that the ice-stream from the Tag Lake has met another descending from the Maartinder in the Sag Valley, but there is no middle *moraine* proving this. On the other hand, travelled granite blocks are but sparsely strewn along the north-western side of the Sag Valley, at the foot of the Slet Mountain. Should the Sag Valley, therefore, be of glacial origin, it might more naturally be attributed to the ice-stream from the Maartinder, but even then eroded before the great inland ice-stream entered it. If, however, this was the case, the

former ice-stream must have been in motion long before the latter, of which there is no probability.

We therefore come to the conclusion that the basin of the Balsfjord, viz., the Tag Lake depression and the Sag Valley, cannot be the result of the erosive action of the inland ice, but that it existed prior to the Glacial age, and that, in fact, the depression in question was the cause of the ice-stream taking this course.

We will now follow the depression through the fjord and adjacent sounds.

As soon as we leave the true bottom of the fjord the travelled blocks are differently situated to those inland. There are plenty of granite blocks to be found, but they are everywhere confined to lower levels, viz., from the shore-line up to 120 feet (38 m.). Above, there is none, and the line of disappearance is very marked. My researches have extended, on the eastern side of the fjord, from the bottom to the sea; on the western side, though they do not extend so far, they go to show that the conditions there are identical with those on the eastern side. It is particularly significant that neither here are the blocks found above a height of 120 feet along the low, transverse ridge which runs from the Balsfjord on one side westwards to the Malangenfjord, and on the other, eastwards to the Lyngen and Ulfs fjords. Thus, the outer Malang isthmus, which, rising slowly to a height of 400 feet (125 m.), leads from the Bals to the Malang fjords, is along the former strewn with blocks, but only at lower levels. Above 120 feet they disappear. From this also it is clear that the inland ice cannot have moved forward across the Slet Mountain and the isthmus between the Bals and Malangen fjords, previously referred to. From the bottom of the Nordkjos, a short bye fjord of the Balsfjord, running eastwards, the Balsfjord isthmus, two miles long, with a height of 250 feet (78 m.), leads to the bottom of the Storfjord in Lyngen. Here, too, the blocks are confined solely to lower levels towards the Nord and Balsfjords. The blocks have not reached as far as across the isthmus to the Storfjord.

The blocks may in the same manner be followed along the Ramfjord, which as a bye fjord runs from the mouth of the Balsfjord eastward to the Bredvik Isthmus. From the southern side of the mouth of the Ramfjord the Anders Valley runs in a southerly direction between lofty mountains and with a steady incline. Here, too, travelled granite blocks are found to a height of 120 feet, *but not a single one above*. The case is the same along the sounds around the town of Tromsö. Further, I have followed the blocks northwards, on the mainland to Tunnes, about five miles from the town, but whether they have travelled further along the Gröt Sound I have not yet been able to ascertain. The same applies to the Kval Sound. But researches made on the islands *outside* this sound prove beyond a doubt that the granite blocks from the Balsfjord cannot have reached these islands by way of the Kval Sound.

The greatest number of travelled blocks along the Balsfjord belong, judged petrographically, to the Divi Valley granite, blocks which might with certainty be referred to the coast granite not having been found. Along the sounds, too, the greatest number of blocks, if not all, may be referred to the Divi Valley granite; but blocks belonging to the gray, streaky gneiss-granite of the Kval Island are also met with here, some of which may even be referred to exact localities in the island. Among the rocks along the Troms Island and adjacent sounds blocks of a coarse-grained syenite are also often found. In the Divi Valley no varieties of syenite appear, but they are often encountered combined with gneiss and gneiss-granite on the coast. Although I have not yet succeeded in finding syenite in place which with certainty can be said to be petrographically identical with that of these travelled blocks, I have every reason to believe that they hail from the west.

We have now followed the course of the blocks along a continuous distance of 84 geographical miles—viz. 48 on the mainland and 36 on the shores of fjords and sounds.

From what I have advanced here as regards the blocks during their journey through the Balsfjord, it seems clear that their transport here cannot be ascribed to a moving stream of inland ice. The sharp line of demarcation, above which no blocks are found, seems in itself to demonstrate this. The line extending for miles along a long fjord and extensive sounds, and being so sharply defined, bespeaks that the transporting agency at work here must have been far more regular during a length of time than a stream of inland ice possibly could be. We have therefore every reason to conclude that these blocks have been carried along the level of the sea on drift-ice, i.e. shore-ice. As the block-transport appears from the first simultaneously along the long stretch of shore from the Balsfjord, and past the Troms Island, a strong in- and outflowing current during the diurnal tides has in all probability been at work at a period when the level of the sea was 120 feet higher than at present. And the strong drift of the ice outwards must have been stronger than the one inwards up the fjord. Travelled blocks of the Kval Island granite are, therefore, not found in the interior of the fjord, but the case is different along the broad sounds about the mouth of the fjord; here the in- and outflowing currents have had alternate sway, and here are also found blocks of the Divi Valley, as well as of the coast granite.

There is another important circumstance which beyond a doubt proves that the inland ice during the Glacial age cannot have moved along this fjord, scouring the bottom. Thus, if we consider the present depth, about 600 feet, and remember that the level of the sea during the Glacial age was about 600 feet higher than at present, and further that great quantities of débris must have been deposited at the bottom of the ice, it is evident that an ice-stream moving through the fjord, and a sixth part of whose volume rose above the then sea-level, must have reached several hundred feet above the former—that is, the outgliding stream must have reached several hundred feet above 120 feet, the line of demarcation for the blocks, as it then lay at least 200 feet below the sea. If, however, this had been the case, granite blocks should now be found at a far greater height than 120 feet. Neither can the Balsfjord during the Glacial age have formed a valley along which the inland ice might move, as, in this case, travelled blocks would have been found along the sides at even far greater heights.

I have, therefore, after the most careful researches here, yard by yard, and extending over many years, come to the conclusion that the Balsfjord is not of glacial origin, but formed an incision or depression in the mountains of older origin than the Glacial age. And this conclusion I believe may, in the main, apply to the question of the formation of all fjords in the north of Norway. But whether it is applicable to all fjords in the whole of Norway I shall not attempt to answer.

There may, however, be reason to assume that the explanation of the fjord-formation in parts which have lain under an earlier Glacial age as being of glacial origin, is rather based on speculation than such careful and minute researches as those I have referred to here, and which may, perhaps, contribute to prove the correct theory.

KARL PETTERSEN

Tromsö Museum

#### VARIABLE STARS<sup>1</sup>

THIS catalogue may be regarded as complementary to the "Catalogue of Known Variable Stars," by the same author, which was read before the Royal Irish

<sup>1</sup> A Catalogue of Suspected Variable Stars, with Notes and Observations, by J. E. Gore, M.R.I.A., F.R.A.S. A paper read before the Royal Irish Academy, May 12, 1884.

Academy, January 28, 1884. It contains a list, including lettered numbers, of 745 stars in which some change of magnitude is suspected. The stars are tabulated in order of Right Ascension for the epoch 1880°, and in separate columns are to be found particulars of the supposed change of magnitude and the authority on which the supposed change rests. In the "Notes and Observations" by which the Catalogue is followed are given particulars of the history of each star, together with observations by the author of such stars as have received attention from him. The work is accompanied by a map showing the distribution of known and suspected variable stars.

A catalogue of this character forms a valuable working catalogue for the observer's use. By further observation suspected variation will in some cases be proved to be real, and the stars claim a place in a catalogue of known variables. A claim of this kind might indeed already be made in the case of Nos. 234, 455, and 635 of Mr. Gore's list. It may just be mentioned in passing that the place of No. 234, U Canis Minoris, is incompletely given in the Catalogue. Its more exact place for 1880 is R.A. 7h. 34m. 49s., Decl. +8° 39' 5". There are other cases in which, though the period is as yet indeterminate, the fact of variation and its amount may be stated with some confidence. On the other hand further observation may tend to throw a doubt on the suspicion of change in the case of other stars, and (as our author observes) "these must of course be removed from future catalogues." In the notes to No. 287 of his Catalogue a Hydræ, Mr. Gore quotes remarks by Sir John Herschel, Dr. Schmidt, and Dr. Gould to the effect that the supposed variability of this star may possibly be due to the influence of its ruddy colour on the estimates of its brightness. Is it not possible that the effect of colour on estimates of magnitude as respects different observers, or the same observer at different times, has hardly received so much attention as it deserves?

Large as is the number of stars included in Mr. Gore's Catalogue, further additions might be made to it. Comparing it, for instance, with the Table of Suspected Variables extracted from Mr. Chandler's unpublished Catalogue by Prof. Pickering, and printed in his "Recent Observations of Variable Stars" in the *Proceedings of the American Academy*, we find some 30 stars which are not included in Mr. Gore's list, and it is probable that others might be found in other quarters also. Indeed the experience of most variable star observers would probably suggest the view that cases of slight but distinctly recognisable light variation are relatively numerous.

A word in regard to No. 445 in the Catalogue may possibly help to avert the chance of a little confusion in the future. This star was entered as U Bootis in Prof. Schönfeld's first Catalogue of Variable Stars, but was rejected by him in his "Zweiter Catalog." There is another star called U Bootis by Mr. Baxendell in a paper in the *Manchester Lit. and Phil. Soc. Proceedings*, vol. xxi. No. 11, the place of which, brought up to 1880, is R.A. 14h. 48m. 47s., Decl. +18° 10' 9". This star has a period of 175'5 days, with a range of magnitude from about 13'5 at minimum to about 9'2 at maximum.

In conclusion we commend to the attention of all who are interested in the subject of variable stars a work the preparation of which must have entailed on the author a considerable amount of labour both as compiler and observer.

#### NOTES

A BERLIN telegram announces the sudden death of Dr. Emil Riebeck, at Feldkirch, where he was preparing for another five years' journey. Our first review in this week's NATURE refers to some of the last results of Dr. Riebeck's journeys. Either directly or indirectly he has done good work for science in

various parts of the world. He was a liberal patron of explorers ; the recent researches of Dr. Schweinfurth, in Socotra, for example, were carried out at Dr. Riebeck's expense. His death is a serious loss to science.

THE death is also announced, at the age of sixty-seven years, of Mr. W. S. W. Vaux, F.R.S., the well-known numismatist and Oriental scholar, and Secretary to the Royal Asiatic Society.

WE have still another death to record this week—that of M. Henri Tresc, an eminent French physicist and mechanical engineer. He was born at Dunkirk in 1814. He studied at the Polytechnic School, and on leaving it entered the corps of the Ponts et Chaussées, but soon afterwards quitted the service in order to devote himself to scientific study. In 1850 he was appointed principal inspector of the French Section of the Exhibition at London, and afterwards became sub-director of the Conservatoire des Arts et Métiers, and he there filled with great distinction the Chair of Industrial Mechanics. In 1872 he was elected a Member of the French Academy. Of his numerous works may be mentioned his "Cours de Mécanique Appliquée" and his "Écoulement des Liquides." The Academy of Sciences, on hearing of his death from the President, M. Boulay, closed the sitting as a mark of grief.

WE are informed that Dr. Barius, Surgeon-General to the French army in Tonquin, died on the 10th in Haiphong after a short illness caused by overwork and anxiety in that unhealthy climate. Dr. Barius is well known to the scientific world from his meteorological writings, especially his able and exhaustive "Recherches sur le Climat du Sénégal." While in Haiphong Dr. Barius took the trouble to make observations every day at 10 a.m. and 4 p.m., which he reduced and forwarded to Hong Kong, and his loss is severely felt ; but some time before his death he mentioned in a letter that the meteorological observatory, of which he had urged the necessity, would be started in a few months.

AT the Oxford Commemoration, last week, the honorary degree of D.C.L. was conferred upon Prof. Huxley.

THE organising committee of Section A of the British Association have arranged for the following discussions at the Aberdeen meeting :—(1) On Kinetic Theories of Gases ; (2) On Standards of White Light. It would be convenient if those wishing to take part in the discussion would send in their names before the meeting to the Recorder of Section A.

THE Council of the Society of Arts have awarded the Society's silver medals to the following readers of papers during the session 1884-85 :—To Anton Jurgens, for his paper on "The Preparation of Butterine." To P. L. Simmonds, for his paper on "Present and Prospective Sources of the Timber Supplies of Great Britain." To A. J. Ellis, B.A., F.R.S., for his paper on "The Musical Scales of Various Nations." To Thomas Wardle, for his paper on "Researches on Silk Fibre." To H. H. Johnston, for his paper on "British Interests in East Africa, especially in the Kilimanjaro District." To E. C. Buck, for his paper on "The Agricultural Resources of India." To Mancherjee M. Bhownagree, for his paper on "The Present Condition and Future Prospects of Female Education in India." To Dr. Frederick Siemens, for his paper on "Tempered Glass." To Frederick J. Lloyd, for his paper on "The Chemistry of Ensilage."

IF the few details that have reached us in the form of newspaper accounts are to be relied upon, Clifton Hall Colliery, near Manchester, in which the great explosion occurred on Thursday last, killing 140 men and boys, appears to have been dry and dusty and at the same time very free from firedamp. It remains to be seen whether those who investigate the causes of this accident will give due weight to the now undeniable influence of

coal-dust, instead of contenting themselves with putting forward the usual set of traditional guesses and assumptions, which, it is to be feared, have too often supplied the place of those careful and exhaustive methods of inquiry and deductive reasoning that are alone capable of dealing with the apparent mystery in obscure cases of this kind. It is noteworthy also that this explosion has occurred in the inspection district in which shot-firing is supposed to be altogether prohibited except when the workmen are out of the mine ; and it will be a curious commentary upon the late high-handed attempt of the Home Office to force a rule of the same kind upon the other mining districts of the country, should it turn out that the accident in question was not originated by a shot but was due to some other cause, such as the ignition of a local accumulation of fire damp. We await the result of the inquiry with very great interest.

MR. J. R. HENDERSON, M.B. (Edin.), F.L.S., zoologist of the Scottish Marine Station, Edinburgh, has been appointed Professor of Biology in the Christian College, Madras. This is, we understand, the first Professorship of Biology which has been founded in India. Mr. Henderson had a very distinguished career in the University, being awarded, among other honours in natural science, the Dobbie Smith Gold Medal. He is at present engaged in describing the Anomura collected during the *Challenger* Expedition.

PROF. T. C. MENDENHALL, of the University at Columbus, has received an appointment in connection with the United States Signal Service. This is an important accession to the scientific staff of the Meteorological Service of the United States, and is another instance of the enlightened policy carried out by General Hazen, the Chief Signal Officer. The high-class contributions to meteorology we receive from time to time from the office of the Signal Service are the outcome of these appointments.

To the *American Meteorological Journal* for June Mr. H. Allen Hazen sends a short but interesting communication on thunderstorms and air-pressure. Thunderstorms may be divided into (1) common storms with light winds, more or less rain, and generally not very heavy thunder ; (2) those preceded or attended by a high and sudden wind ; and (3) those that may be termed electric storms, mostly experienced in the west of the States, and of which little has been written or is known up to the present time. As to this third class, it is alleged that storms occur in the west with heavy electric discharges, and more or less wind *but no rain*. These storms the Signal Service proposes to investigate most carefully, particularly since, if it be conclusively shown that thunderstorms occur unaccompanied by any rain, a contribution of no ordinary importance will be made to the theory of the thunderstorm. It gives us the greatest pleasure to learn that the American observers are urged to take readings of their aneroid barometers every five minutes during thunderstorms, together with non-instrumental observations of rain and other accompaniments of the storm. In this department of meteorology, accurately observed facts continue still to be the great desideratum.

DETAILS of the recent violent volcanic eruptions in Java, of which brief telegraphic intelligence has already been published, have now reached Holland. The volcano of Smeru has been active for many years, casting out fire and smoke, but on April 17 and 18 an eruption of extraordinary violence occurred. The mountain is regarded as the highest volcano in Java, and takes the form of a handsome, regular cone. On the present occasion the side of the mountain for one-third of the way down from the summit is described as having been burst open, a tremendous cleft being formed, from which a torrent of lava and mud was ejected. A whole estate called Kalibening was overwhelmed, the manager and a large number of Javanese labourers being

carried away by the torrent. From the reports it appears that the eruption of Smeru was accompanied by volcanic disturbance all over the western part of Java. A mud spring, or rather lake, bubbled up into the Preanger, in West Java; a volcano, Slamet, lying west of the Merapi (itself a quiescent volcano), has manifested signs of renewed activity, as has KI<sup>1</sup>, farther to the east. Lamongan, lying still farther eastward, throws out showers of ashes, and in Rotti, an island near Timor, mud has issued from the side of a mountain, and has overflowed a district described by the natives as twenty minutes' journey in breadth.

M. GASTON TISSANDIER made, on Friday, June 20, an ascent with a photographic apparatus to take instantaneous views. Not less than twenty-four were obtained on the trip, which began at 2 o'clock and lasted up to 6. The departure took place at Point du Jour (Paris), and the descent in the vicinity of Rheims.

MR. R. ANDERSON, F.C.S., has in the press a new and enlarged edition of his work on "Lightning Conductors, their History, Nature, and Mode of Application." Messrs. Spon are the publishers.

MR. MORRIS, the Government botanist of Jamaica, delivered an address before the Jamaica Institute on the 7th ultimo on the scientific work done, and still to be done, by that establishment, more especially in the local museum. The latter is still in course of formation, but during the past four years there have been brought together collections of the fish, birds, insects, shells, and an illustrative collection of other island productions. The geological collection is described as being of a most complete and useful character. It shows not only the nature, age, and character of the rocks, their chemical constituents, fossil contents, and mineral wealth, but also deals with such topics as the nature and origin of soils, the character and quality of building stone, &c. The collection of Jamaica birds contains about 100 specimens, leaving 89 still to be added before it can be regarded as complete. The insects of Jamaica, Mr. Morris says, are comparatively little known to science, and this field is especially recommended to local collectors. Up to a few years ago the fish of Jamaica could best be studied in Boston and Washington Museums, but the local museum has lately commenced a collection of food fishes, and about 60 species are already carefully arranged and classified. Little, however, has been done of a practical and tangible character to develop the fisheries of the island. 630 species of land and freshwater shells have been found in Jamaica; these are being carefully arranged, and indicate that the island forms a rich province in the class Mollusca, and that "the classes of phenomena within her narrow limits afford room for the highest order of scientific studies." Jamaica is particularly rich in ferns; it contains about 500 species, which is one-sixth of the ferns of the whole world. The orchids and grasses are also being prepared for the museum, and it is hoped as opportunity offers to add a good collection of the medicinal and industrial plants. Here, as in his annual reports, which we have noticed on their appearance, Mr. Morris dwells on the immense economical value of a properly ordered and complete museum to an agricultural colony like Jamaica. There is no lack of materials; the difficulty has been to collect, preserve, and systematically arrange collections and place them in such a state and under such conditions as to conduce to their due and proper utilisation.

IN the first days of August next an International Botanical and Horticultural Congress will be held in Antwerp. Amongst the questions which will be suggested for special consideration is the flora of the new Congo Free State, the methods of culture already existing there, and the possibility of acclimatising new plants. The commission appointed to carry out the preliminary arrangements for the Congress has drawn up a series of ques-

tions, which, with the help of the Association Internationale Africaine, has been sent out to the Congo for replies. A special sitting will be devoted to this subject, and a herbarium of the principal flowers and plants of various neighbourhoods in the State and a collection of fruits and seeds will be accessible to members. The queries sent to the Congo refer to the nature of the soil; the maximum and minimum temperatures; the climatic conditions; the conditions favourable to cultivation, and those which are unfavourable; the food, medicinal, poisonous and industrial plants; the help which Central Africa offers to botanists for the study of tropical flora and physiology; the cultivation of vegetables on the Congo; the principal enemies of cultivation in the vegetable and animal kingdoms; and the best mode in which botanists and gardeners can utilise the labours of the Congo explorers. Like other recent Congresses the International Botanical and Horticultural Congress this year will apparently be mainly occupied with questions relating to Mr. Stanley's new State.

WE have received from Mr. F. W. Putnam, the Curator of the Peabody Museum of American Archaeology and Ethnology, two papers by him: one, a first notice of the pine grove or forest river shell-heap, near Salem; the other, remarks on chipped stone implements, which we noticed on its appearance in the *Bulletin of the Essex Institute*.

MR. J. MACDONALD CAMERON has printed a report on the bituminous deposits of the Camamū basin of the province of Bahia in Brazil. In addition to the purely commercial portion of the report, there is much interesting information with regard to the various descriptions of these oleaginous deposits. Mr. Cameron has some interesting remarks on the influence of the mangrove on the muddy swamps on the coast. The dirty greyish black mud in which the mangrove vegetation is very luxuriant, resembles that noticeable in England in rivers and streams on the banks of which oil or soap works are situated. He inclines to the opinion that this mud is principally formed by the continuous decomposition of the roots and branches of the mangrove trees. The tidal currents ebb and flow slowly, and hence do not sweep away the mud. Thus abundant food for the tree is ensured, "as well as a store of oleaginous material for the use of distant generations of human beings."

WE have received the report of the Hackney Microscopical and Natural History Society for the past year. Mr. Greenhill's paper on Hackney Brook is of much interest, although the title is suggestive of the investigation in the Hampstead ponds undertaken by the immortal Pickwick Society. Mr. Greenhill has hitherto classified the stone implements which he has found in north and north-east London into (1) Hackney brook, (2) Lea valley, (3) Thames valley; and the purport of his paper is to arrive at a sound theory as to the comparative age of these three valleys and their implements. The principal conclusion of the paper is that the brook and its valley were not formed till long after the Stone age. Dr. Cooke's presidential address is a novelty; it is a Christmas vagary, describing the characteristics, the whims and oddities of the individual "chips" who attend one of the society's excursions.

THE Annual Report of the Bedfordshire Natural History Society refers to the work of preparing a new flora of the county. It is hoped that the first part of the work will shortly be ready for print. The *Transactions* of the past two years have contained a complete list of the phanerogams, mosses, and Characeæ of South Bedfordshire, by Mr. Saunders, and attempts are being made to form similar lists for other parts of the county. The papers read were few in number, but these do not represent the work of the Society. A scheme of village lectures on scientific subjects has been carried out with success.

IN a paper read at the last meeting of the Librarians' Association, Mr. J. R. Boosé describes the progress of Colonial public libraries. Commencing with those in the Dominion of Canada, he stated that as far back as 1779 there was a public circulating library at Quebec. He then traced the progress of the public library system up to the present, giving a detailed account of the Parliamentary Library at Ottawa, and also referring to the recent establishment of free public libraries. He then traced the progress made in the Australasian colonies, dealing separately with the libraries of Victoria, and stated that the establishment of public libraries in those colonies only dated from the second decade of the present century. Their growth, however, had been of extraordinary rapidity; the statistics for Victoria showed that there were 143,073 volumes in the public library of Melbourne, 317,295 in the libraries of the colony, and that these institutions were visited in 1883 by 3,100,000 persons. Mr. Boosé, after describing the libraries of the other Australian colonies, referred to those of the Cape Colony, Natal, Singapore, Jamaica, British Guiana, Trinidad, the Bahamas, &c., and, in conclusion, observed that it was scarcely possible to overrate the advantages of these institutions, inasmuch as, in addition to their existing collections of books, every effort was made to enrich them by such valuable works of reference as were too costly to be purchased privately, and were only presented to libraries having a recognised status. He thought therefore that the Colonial Governments should provide means annually for their proper maintenance, and not throw the cost of them on the municipal authorities.

THE additions to the Zoological Society's Gardens during the past week include two Barbary Apes (*Macacus inuus*) from North Africa, presented respectively by Mrs. Allison and Mrs. D. Fox Tarrant; two Common Marmosets (*Hapale jacchus*) from Brazil, presented by Col. Howell Davis; two Brown Bears (*Ursus arctos*) from Russia, presented by Mr. Walter Holdsworth; two Bandicoot Rats (*Mus bandicota*) from India, presented by Col. C. S. Sturt, C.M.Z.S.; an American Robin (*Turdus migratorius*) from North America, presented by Mr. H. Keilich; two Partridges (*Perdix cinerea*), British, presented by Mr. H. J. Snellgrove; an Azara's Fox (*Canis azarae*) from South America, a Pleasant Antelope (*Tragelaphus gratius* ?) from West Africa, six Common Chameleons (*Chamaeleo vulgaris*) from North Africa, purchased; a Japanese Deer (*Cervus sika* δ), three Canadian Beavers (*Castor canadensis*), a Chiloe Wigeon (*Mareca chiloensis*), seven Australian Wild Ducks (*Anas superciliosa*), bred in the Gardens.

#### OUR ASTRONOMICAL COLUMN

THE PERIODICAL COMETS OF DE VICO AND BARNARD.—As was first pointed out by Prof. Weiss, there is a certain degree of resemblance between the elements of the comet discovered by Barnard in July, 1884, and those of the comet of short period detected by De Vico in August, 1844, which Leverrier considered was probably identical with the comet observed by Lahire at Paris in 1678, though not known to have been seen in the long intervening period. It appears from Brünnow's minute investigation of the orbit of De Vico's comet that the mean motion at perihelion passage in 1844 is not determinable from the observations within very narrow limits, as might rather have been expected, considering the degree of precision with which that comet was observed from the beginning of September to the end of December. Mr. Otto Struve's observations in particular being of remarkable excellence. According to Brünnow's later calculations, the results of which were published in his "Ann Arbor Notices," the mean motion was close upon 650° daily, but he considered that it might be as small as 640° or as large as 660°, or, in other words, that the period of revolution at perihelion passage in September, 1844, might be as long as 2025 days, or it might not exceed 1964 days. Dr. Berberich finds the period of Barnard's comet 1959 days, and Mr. Egbert, of Albany, U.S., 1970 days, so that the periods of the two

comets are pretty accordant; but the interval 1844-1884 does not correspond thereto, and the differences that exist in the other elements, notwithstanding the general similarity remarked by Weiss, point to considerable perturbation in this interval, supposing the identity of the comets. De Vico's comet in the orbit of 1844 could not have approached near to the planet Jupiter, to which body we are accustomed to look, as the great disturber of cometary orbits, but there is the possibility of a very close approach to the planet Mars, and this is also the case in a striking degree with Barnard's comet, which, in Dr. Berberich's last ellipse, is less than 0°08 of the earth's mean distance from the orbit of Mars in about 350° 50' heliocentric longitude; as already pointed out in this column, there may have been a close approach of the two bodies at the end of 1873 or beginning of the following year. The nearest approximation of the orbits of 1844 and 1884 is 0°043 in heliocentric longitude 310°, and there is another approximation, 0°065, in 143°. At present, however, the identity of the comets of De Vico and Barnard is to be regarded as at least doubtful.

THE DOUBLE-STAR 19 (HEV.) CAMELOPARDI.—The annual proper motion of the principal component of this double-star, which is 2 634, resulting from a comparison of Groombridge's Catalogue (mean year of observation 1858·4) with the Greenwich Catalogue of 1872, appears to be  $-0^{\circ}297$  in right ascension, and  $+0^{\circ}164$  in declination, the accurate trigonometrical formula being employed. For the relative motion of the smaller component with respect to the principal one, we may compare Struve's epoch for 1834 with a mean of the measures of Dembowski, Flammarion, and Asaph Hall between the years 1875 and 1879, viz.—

|         |              |               |
|---------|--------------|---------------|
| 1834·15 | Pos. 348°57' | Dist. 34°042' |
| 1877·29 | " 111 ... "  | 20°303'       |

Whence we find for the annual relative motion in right ascension  $+0^{\circ}858$  and in declination  $-0^{\circ}302$ , and we have thus a confirmation of the opinion expressed by M. Flammarion in his "Catalogue des Etoiles Doubles et Multiples en Mouvement Relatif certain," that the smaller component has a real motion, more rapid than that of the principal star, of contrary sign, and not far from parallel to it.

A DAYLIGHT OCCULTATION OF ALDEBARAN.—On July 9, civil reckoning, Aldebaran will be visibly occulted in this country about noon. If the distribution formulæ of Littrow and Woolhouse are applied, the following expressions result for finding the Greenwich mean times of disappearance and re-appearance, and the angles from north point—

Disappearance ... July 8, 23h. 26'7m.  $-[0^{\circ}2369]L + [9^{\circ}5144]M$   
Reappearance ... July 9, oh. 15'3m.  $+[9^{\circ}1126]L - [9^{\circ}4189]M$

Angle at Disappearance  $49^{\circ}3' + [0^{\circ}542]L - [8^{\circ}004]M$   
Reappearance  $321^{\circ}6' - [0^{\circ}528]L - [8^{\circ}701]M$

Here the latitude of the place is put  $= 50^{\circ} + L$ , and M is the longitude in minutes of time, positive towards the east. If we apply the formulæ to Oxford, we have  $L = +1^{\circ}76$ , and  $M = -5^{\circ}043$  m., and hence

Disappearance, July 8, 23h. 22'0m. at  $55^{\circ}$ .

Reappearance July 9, oh. 14'2m. at  $316^{\circ}$ .

It should be added that the above quantities within square brackets are logarithms.

#### ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, JUNE 28 TO JULY 4

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

##### At Greenwich on June 28

Sun rises, 3h. 48m.; souths, 12h. 2m. 58'7s.; sets, 20h. 18m.; decl. on meridian,  $23^{\circ}16' N.$ ; Sidereal Time at Sunset, 14h. 46m.

Moon (one day after Full) rises, 19h. 58m.\*; souths, oh. 27m.; sets, 4h. 58m.; decl. on meridian,  $18^{\circ}1' S.$

| Planet  | Rises | Souths | Sets  | Decl. on meridian |
|---------|-------|--------|-------|-------------------|
|         | h. m. | h. m.  | h. m. | °                 |
| Mercury | 3 43  | 12 8   | 20 33 | 24 33 N.          |
| Venus   | 4 56  | 13 8   | 21 20 | 22 55 N.          |
| Mars    | 1 50  | 9 53   | 17 56 | 21 25 N.          |
| Jupiter | 8 45  | 15 50  | 22 55 | 11 45 N.          |
| Saturn  | 3 19  | 11 29  | 19 39 | 22 31 N.          |

\* Indicates that the rising is that of the preceding day.

| Occultations of Stars by the Moon |               |      |        |       |  |          |
|-----------------------------------|---------------|------|--------|-------|--|----------|
| June                              | Star          | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image |          |
|                                   |               |      |        |       | h. m.  | h. m.    |
| 30                                | 13 Capricorni | 6    | 0 0    | 1 7   | 119° 239°  |          |
| 30                                | 14 Capricorni | 5    | 1 36   | 2 22  | 158° 233°  |          |
| July                              | 2 B.A.C.      | 7774 | 6      | 2 37  | 3 59   | 99° 302° |

| Phenomena of Jupiter's Satellites |       |               |       |       |                 |  |
|-----------------------------------|-------|---------------|-------|-------|-----------------|--|
| June                              | h. m. | July          | h. m. |       |                 |  |
| 29                                | 20 26 | I. tr. ing.   | 2     | 22 35 | III. occ. reap. |  |
|                                   | 22 46 | I. tr. egr.   | 3     | 20 28 | IV. ecl. reap.  |  |
| 30                                | 20 56 | I. ecl. reap. |       |       |                 |  |

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

July 3, 23h.—Sun at greatest distance from the Earth, the distance being one-sixtieth part greater than the mean distance.

#### GEOGRAPHICAL NOTES

THE Royal Geographical Society have decided to send out another African expedition. This time the region to be explored is one of more than usual interest, and the method of procedure will be considerably different from that which has been hitherto usually followed. We have had many lines run through Africa in all directions, and what is now needed is the leisurely study of the continent in detail. This is what will be done by the expedition which will leave England in August next, under Mr. J. T. Last, who, as a lay agent of the Church Missionary Society, has done admirable work in the Zanzibar interior. Mr. Last, after making up his caravan at Zanzibar, will proceed south to Lindi, to the north of the mouth of the Rovuma River. Thence he will proceed to the confluence of the Rovuma and Lutende Rivers, and fix the longitude of the junction—an important geographical point not yet settled. He will then go on in a generally south-westerly direction, and, before reaching the north end of Lake Shirwa, turn southwards and make for the Namuli Hills, which, with other new features in this region, were discovered by Consul O'Neill in the end of 1883. Here Mr. Last will establish himself and make a detailed study of the whole region in all its aspects. He will make a complete survey of the surrounding country, its topography, its people, its botany, economic products, climate, and languages. When this is completed Mr. Last will enter the valley of the Likungu River, which rises in the neighbourhood of these hills, and follow it down to the coast of Quizungu, whence he will travel south to Quilimane or north to Angoche, and thence to Mozambique. Mr. Last will make a special point of collecting all possible information concerning the country he passes through, its changes; its people, their customs, languages, &c.; the climate, its sanitary conditions, and its suitability for the introduction of European and other economic plants.

THE last number of Petermann's *Mittheilungen* contains the conclusion of Herr Schunke's account of Kaffraria and the eastern borderlands of Cape Colony; the Panama Canal, with a map, by the Editor; the German possessions on the Slave coast, also with a map, by Herr Langhans; the latest explorations in Costa Rica, by Dr. Polakowsky. This last is specially interesting. It is a continuation of a paper, published two years ago, and describes ten additional journeys to various parts of Costa Rica by Dr. Thiel the bishop. It is unfortunate for science that this ecclesiastic, whose energy in educating his flock and whose thirst for scientific investigation are alike remarkable, should have been expelled by the Costa Rican Government, and that in such haste that he was compelled to leave behind him all his journals, collections, scientific observations, &c. He travelled and lived much amongst the various tribes of Indians, and studied their dialects, the antiquities, and ethnology of the country. He is at present visiting the eastern coasts of Nicaragua and Honduras in order to collect Indian antiquities and the remnants of Indian languages. The same paper also contains a report of a journey in Costa Rica by Padre Fernandez.

A CORRESPONDENT writes to *Ausland* from Santiago to correct a mistake as to a reported discovery of a glacier in Chile. The glacier in question is called the Ada glacier, and occupies the upper end of the Cajon de los Cipreses, a branch of the valley of Cachapual. In a note which appeared in the fourth

number of *Ausland* this year and was copied from the *Proceedings* of the Royal Geographical Society, the discovery of this glacier was attributed to Dr. Güssfeldt. Some years previously the same discovery had been ascribed to Mr. Charles Wiener. The fact is, the correspondent states, the glacier has been known to the visitors to the baths of Cauquenes for the last twenty years at least. MM. Wiener and Güssfeldt, like other visitors to the baths, had had their attention called to it, and each in turn was consequently credited with its discovery.

THE French Minister of Public Instruction has published a report which he has received from M. Chaffanjon, a professor in Guadeloupe, giving an account of his mission on the Orinoco. In order to investigate fully the hydrography of the river he has often found it necessary to travel far away from the banks on both sides, and he has thus been able to survey the former beds. He has also obtained the materials for a geological map of the region and for a description of the phenomena attending the formation of this part of the earth's crust. Hitherto we have had only vague ideas respecting the Indian races, because they were without history or ancient remains. Prof. Chaffanjon has discovered in five different places inscriptions and pictures in granite, which he has carefully copied. He has collected a crowd of ethnological objects amongst the Caribs, the Panaies, and the Mapoyes. He hopes also to be able to fill certain gaps in the zoological and botanical collections in the Paris Museum. The report is accompanied by a sketch on a scale of 1 to 660,000 of the course of the Orinoco between Caicara and Ciudad Bolívar, which gives a considerable number of names new to geography.

THE Berlin Geographical Society has decided to erect a monument at the burial place of the late Dr. Nachtigal, at Cape Palmas, and all Germans are invited to send contributions to the fund for this purpose.

#### ELECTRICAL DEFINITIONS, NOMENCLATURE, AND NOTATION<sup>1</sup>

WITH the rapid progress that has lately been made in electrical science and its applications, there has sprung up a new and fast-increasing class of practical electricians. These, partly from necessity and partly from well-meaning respect, have adopted and applied the old terms and expressions which appeared suitable to their predecessors, as well as coined not a few new ones, until now their vocabulary is in considerable confusion, and, as all must admit, requires sifting and reform.

Nothing is more tantalising and perplexing than the different modes of expression and symbols used by different authors, and sometimes by the same author, to explain and interpret one and the same thing or result. All this might be avoided if an international system of definitions, nomenclature, and notation was agreed upon and legalised. The rapidity with which the new definitions of the ohm, ampere, and volt (issued and legalised last spring at Paris by the International Congress of Electricians) were universally adopted, shows this. These definitions should be still further extended to other electrical units. They should embrace a suitable system of notation, whereby electrician could represent in symbols and letters, terms, expressions, and formulae of common occurrence, in a similar manner to that adopted by chemists in connection with chemical elements and their combinations. Last session the author promised a communication to the Society on this subject, and, being again reminded by the Secretary of his unfulfilled promise, he now submits a few of the more apparent instances where ambiguity or want of uniformity exists, with suggestions, in the hope that a discussion may follow, and that a Committee of this Society may be formed to consider and draw up a series of definitions, nomenclature, and notation that would be generally acceptable. The proposed Committee might then confer with the French Committee, also with a similar Committee appointed by the British Association, and, finally, this important question should be referred to the International Congress of Electricians, in order that they may legalise and issue their decisions in a similar manner to that adopted by them in the case of the ohm, the ampere, and the volt. Undoubtedly, if such a course were adopted, most beneficial results would accrue to all concerned.

<sup>1</sup> Paper read before the Society of Telegraph Engineers and Electricians on May 14, 1885, by Prof. Andrew Jameson, C.E., F.R.S.E., Member Principal, College of Science and Arts, Glasgow.

Only last November M. Hospitalier brought this subject prominently before the International Society of Electricians at Paris, and strongly advocated an investigation, so that you shall no doubt have their support and concurrence.<sup>1</sup>

*Examples.*—(1) At the very outset students are perplexed by such different terms as "Ordinary" or Static or Frictional or High-tension Electricity." One author will tell his readers of students : "For a long time the name Frictional Electricity was given to a group of phenomena produced by electrical charges. This is an improper expression, because friction is only one means for producing electrical charges."<sup>2</sup> Another says : "Static Electricity is, however, a misnomer : it has no existence : all the phenomena are due to static strains, but there is always a gradual loss called leakage, which is, however, the current due to the actual conductivity of all circuits, and every motion set up by so-called static electricity implies a transfer of energy and action occurring in a field of force set up in the form of strains in the particular inductive circuit in which the motions occur."<sup>3</sup> A third objects to the word "tension" in respect to electricity, and points out that "all the phenomena observable in connection with so-called High-tension Electricity may be produced by electricity drawn from batteries or dynamos if the electromotive force or difference of potential is sufficiently increased." Would not the term "Electro-statics" be more suitable and comprehensive ?<sup>4</sup>

(2) The old nomenclature "vitreous" and "resinous," as applied to substances which, when rubbed by certain other substances, produce opposite electrical properties, and the scholastic one and two fluid theories based upon these effects, should be discarded for the more comprehensive modern theory of electric polarity of molecules or continuous particles, expressed by "positive" and "negative," or by the algebraical signs (+) and (-).

(3) "Electrics," "dielectrics," "non-conductors," "insulators," and "isolators" are terms used by different writers to express a condition or behaviour of certain materials with respect to electricity, in contradistinction to the terms "non-electrics" or "conductors" as applied to other materials. The words "electrics," "non-conductors," and "non-electrics" are, strictly speaking, meaningless, because all materials may be termed electrics and all conductors, only differing in degree. The words "isolators" and "isolation" (from the French verb *isoler*, to isolate or separate) should give way to "insulators" and "insulation" as applied to substances which offer a comparatively greater resistance to electricity than semi or good conductors used in connection with the apparatus being referred to at the time.

The term "dielectric"<sup>5</sup> was first used by Faraday on finding that conduction was effected by induction (of polarity from molecule to molecule), and is generally employed by practical electricians when speaking of the inductive capacity of the insulating material surrounding the conductor of leading wires or submarine cables, or that placed between the plates of a condenser. In this sense, viz., of a body transmitting electric induction, or capable of undergoing electric stress, and retaining the stressed condition, it is a very appropriate term to use.

<sup>1</sup> Communication faite à la Société Internationale des Électriciens, le 5 Novembre, 1884, par M. E. Hospitalier sur L'Unité de Définitions, Conventions, Notations, et Symboles Électriques (*vide L'Électricien*, 15 Décembre, 1884).

<sup>2</sup> Sur la proposition du Président, l'assemblée décide qu'une Commission spéciale sera nommée à l'effet de rechercher les meilleures méthodes à adopter pour les notations électriques et de codifier ces notations.

<sup>3</sup> M. le Président propose, au nom du Bureau, d'appeler à faire partie de la Commission des notations électriques—

MM. Ed. Becquerel  
E. E. Blavier  
Marié-Davy  
Tresca  
Maurice Lévy  
G. Lippmann  
Félix Lucas  
Mercadier  
De Meritens

MM. H. Becquerel  
G. Cabanelas  
J. Capentier  
Gauthier-Villars  
E. Hospitalier  
D. Monnier  
D. Napoli  
Pollard  
J. Raynaud

M. V. Williot.

"L'assemblée adopte cette liste à l'unanimité."

<sup>2</sup> The term used by Faraday. (See "Experimental Researches," by Michael Faraday, p. 82, Art. 264.)

<sup>3</sup> "Electrician's Pocket-Book," by E. Hospitalier, p. 5.

<sup>4</sup> "Electricity," second edition, by Sprague, p. 6, Art. 20.

<sup>5</sup> "Electricity and Magnetism," by Clerk Maxwell, vol. i., part 1.

<sup>6</sup> Faraday's "Experimental Researches," p. 364. "I use the word dielectric to express that substance through or across which the electric forces are acting." (See also pp. 537, 538.)

(4) The term "accumulator" is the name given in several text-books to apparatus, such as the Leyden jar or condenser, for receiving and retaining quantities of electricity, but has been lately inappropriately applied to secondary batteries, which do not accumulate electricity.

(5) "Cascade," as applied to Leyden jars, should give way to "series."

(6) "Tension"<sup>1</sup> "potential," and "electro-motive force," are terms which, when variously and indiscriminately applied, have given rise to considerable confusion, and a great deal of writing in trying to define them. If we consider "tension" as simply the stress put upon the current by the electro-motive force, and not in the sense that it used to be employed (for example : "Join up a battery or set of condensers for tension"), it might do very well if kept in its place ; but it can easily be dispensed with. "Potential" is a word that has also given great trouble.

We find in Sprague's "Electricity"<sup>2</sup> no less than three pages devoted to an explanation of the different ways in which the words "tension" and "potential" are employed. Clerk Maxwell said : "The theory of electro-statics is greatly simplified by the introduction of this new conception of potential." "As soon as we pass from electro-statics to other departments of electrical science, we find that the conception of potential is no longer available, except when used in a restricted sense and under carefully-defined conditions." "In other parts of electrical science we have to deal with electro-motive force in cases where 'potential' and consequential 'potential difference' are words without meaning." Prof. Fleeming Jenkin, in his well-known text-book on electricity and magnetism, devotes twenty-six pages to "potential," and defines "unit difference of potential or electro-motive force in electro-static measure to exist between two points when the unit quantity of electricity in passing from one to the other will do the unit amount of work." "The property of producing a difference of potential may be said to be due to a peculiar force, to which force the name *electro-motive force* is given." "The words *electro-motive force* and *difference of potential* are used frequently one for the other, but they are not, strictly speaking, identical." "Electro-motive force is the more general term of the two, and includes difference of potential as one of its forms." "Potential" might well be reserved for electro-statics, and "electro-motive force" for electro-kinematics, or current electricity, and thus prevent confusion. The word "electric-pressure" has come into vogue lately, and strongly appeals to those of a mechanical turn of mind, seeing that the hydraulic simile of "head" or "pressure" is often brought forward to assist in explaining the terms "potential" and "electro-motive force."

(7) In magnetism we find the same want of uniformity exists. Take the case of a freely-suspended magnetised needle. The pole which turns towards the geographical north is variously called the "austral pole," "north pole," "north-seeking pole," marked pole," and is painted red by Sir Wm. Thomson, while Sir Wm. George Airy, Prof. Guthrie, and others paint it blue. It is sometimes indicated by French makers by the letter *A*, and by British by the letter *N*. The pole which turns towards the geographical south is correspondingly called the "boreal pole," "south pole," "south-seeking pole," "non-marked;" painted blue by Thomson, and red by Airy, Guthrie, and others, and indicated by the letter *B* or *S*. Such is the general doubt and diversity in regard to the nomenclature on this subject, that each author on magnetism considers it necessary to state at the outset which term and symbol he intends to apply. If once for all the pole which turns towards the north was termed the "north pole," painted blue, and indicated by the letter *N*, and the opposite pole was termed the "south pole," painted red, and indicated by the letter *S*, much vexation would be saved. The French terms "austral" and "boreal," with letters *A* and *B*, should be obliterated. In this way the earth would have a uniformly recognised polarity, which would of course be opposite to that of the magnetised needle—in other words, the true north pole of the earth would be that situated near the geographical south pole.<sup>3</sup>

(8) Sailors and some writers on the mariner's compass call the angle which the magnetic meridian makes with the geographical meridian the "variation" of the compass, while electricians

<sup>1</sup> For a good definition of these terms, see "Electricity and Magnetism," by Clerk Maxwell, vol. i., p. 49. <sup>2</sup> 1884 edition, pp. 58-62.

<sup>3</sup> Sir Wm. Thomson calls the magnetic pole of the earth, situated near the geographical north, the "north pole" and the end of the magnetised needle which points towards it the "true south pole" of the needle, and paints it red

call it the "declination." Variation is, properly speaking, the hourly, diurnal, annual or secular changes which occur in the value of the elements of terrestrial magnetism. This leads to great confusion and argument between the electricians and the officers of telegraph steamer. The declination for each place is marked on the Admiralty charts. Sailors also speak of the "deviation" of a compass, meaning by that the local error due to the resultant of the quadrantal, semicircular, and heeling errors, &c. It would be far better if they simply spoke of the "compass error," or angle which the meridian of their compass-needle makes with the true north and south magnetic bearings. This deviation or compass error arises from local magnetic influences. Sir William Thomson's well-known compass, when properly adjusted on board a ship, has no compass error, and therefore the only thing to guard against and correct for in the steering of a ship is the declination of the place where the ship may be at the time of observation. Of course, if the magnetism of the ship changes in the slightest, due to a change of cargo or position thereof (if of iron or steel), or due to buffeting the waves for some time on one course, a slight error will creep in, but the compass can be soon adjusted to the new condition of affairs, and the officers have therefore seldom to think of or even speak of "deviation" or "compass error."

(9) When we come to electricity generated by batteries, we find the expressions "galvanism," "voltaic electricity," "dynamic electricity," "electro-kinetics," "current electricity," &c., according to the fancy of the writer or speaker. Surely one name might suffice; and certainly the older term "galvanism" and "voltaic electricity" might well be left to the past. The simple term "current electricity" seems to command itself, as most of the effects in connection with this branch of the subject have reference to electricity as if it was in motion or distributing itself over a conductor.

(10) "Density of current" and "intensity of current" often cause great confusion. "Density of current" should only be used in the case of electrolysis or electro-deposition of metals. Here it means the amperes per unit of surface of the cathode. In electro-statics "surface density" or "electric density" means the quantity per unit area of surface. "Intensity" was used at one time in the same sense as "electro-motive force" is now, and therefore not so much out of place there; but several writers, notably Prof. Silvanus Thompson, have thought fit to borrow the French term "*intensité de courant*" wholesale, instead of a translation thereof, and to symbolise it by the letter *I*. The literal translation of the French word *intensité* being strength or amount, therefore the expression "current strength," or simply "current," symbolised by *C*, is far preferable, for it conveys the correct meaning of the quantity in a given time. With a little pressure, French electricians would no doubt agree to the symbol *C* instead of *I*, to promote uniformity. Then *I* might be reserved for intensity of magnetism, where it suits very well.

II. "Positive electrode," "(+)" terminal," "zincode," "anode," "positive pole," and "negative plate," severally used by different writers to designate that end of a cell, battery, or pile where the current leaves, and "negative electrode," "(-)" terminal," "platinode," "kathode" or "cathode," "negative pole," "chlorous pole," "positive plate," where the current returns to or enters the same, requires revising and simplifying, more especially when we consider that the end plates of a battery are of opposite sign to their electrodes or terminals, and that the nomenclature is still further complicated when we come to consider secondary batteries or electrolysis by the terms "anion," "cation" or "cation," and "ions." Take, for example, the definition given by Sprague<sup>2</sup> of "anode": "The positive electrode or pole of a battery; the wire or plate connected to the copper or other negative element of the battery; the plate which leads the + current into a solution to be decomposed, and at which are set free the oxygen, acid radicals and all -ions (anions).<sup>3</sup> In electro-metallurgy it is usually formed of the metal to be deposited, in which case it is called the soluble anode or pole"!!

<sup>1</sup> See Ferguson's "Electricity," second edition, by Prof. Blyth, p. 164. The term "electro-kinematics" has been used by Clerk Maxwell to cover a large part of this subject, such as "electric current," "conduction," "resistance," "electro-motive force," "electrolysis," &c. (See "Electricity and Magnetism," by Clerk Maxwell, vol. i, part 2.)

<sup>2</sup> Sprague's "Electricity," 1884 edition, p. 624.  
<sup>3</sup> See Faraday's "Experimental Researches," articles 661 to 667, on Definitions of New Terms, where he very clearly points out the meaning he attaches to the words "electrode," "anode," "cathode," "ions," "anion," "cation," &c.

12. Again, we have the two different ways of graphically representing a battery



according to the whim or fancy of the writer. Practical submarine electricians were the first to use this very neat and handy way of representing a battery and its poles, and always adopted the former method, with the long thin vertical line for the plate where the current leaves, and the thick short line for the plate where the current returns to the battery. Why should this have been departed from? It is a mere arbitrary arrangement, but, being a most convenient symbol, it should be used in a uniform manner. Mr. John Munro proposes that the symbol for a secondary battery should be a modification of this, viz.,



the current outside the cell proceeding from the long line to the short one.

13. "Parallel circuit," "multiple arc," "loop circuit," "in loop," "derived circuit," "shunt circuit," are all expressions to signify pretty much the same thing, where one expression, "shunt circuit," would do.

14. "Polarisation" is a term used in many different senses—for example, the polarisation of battery plates, molecular polarisation due to electrification or magnetisation, polarisation of light due to magnetism, &c., as in Dr. Kerr's experiments. Some reform is required here.

15. Coming to telegraphy, telephony, and electric lighting, we find, as M. Hospitalier points out, "the words 'generator,' 'receiver,' 'transmitter,' and 'motor' are mixed up by different inventors, sometimes through ignorance, sometimes willingly." "A 'generator' is an apparatus which, receiving energy of a certain nature, produces an energy of another nature, and it borrows its name from the nature of the energy which it generates. A 'receiver' is an apparatus analogous to the generator, but it borrows its name from the energy which it receives." "A given apparatus is at once a generator and receiver—for example, an electric motor is a generator of mechanical energy and a receiver of electrical energy." "The name 'transmitter' ought to be reserved for an apparatus which, receiving an energy of a certain kind, produces or brings into play an energy of the same kind or of the same form." For example, a relay on a telegraph system, or induction coils as used on a trunk telephone line with several subscribers' lines at each end, or in electric lighting on the Gaulard and Gibbs' system, lately tried in London. Professor Silvanus Thompson uses the phrase "Dynamo-electric machinery" in the most general etymological sense of the term, as meaning machinery for converting the energy of mechanical motion into the energy of electric currents, or vice versa, excepting such induction machines as Holtz, Voss, &c. He thinks this reduces the ambiguity to a minimum, and leaves the word "motor" to be applied, if desired, to the steam-engine, water wheel, &c., from which the mechanical motion is derived. The terms "magneto-electric machine," as applied to a dynamo fitted with permanent field-magnets, and "electro-magnetic machine" to a series, separately-excited, shunt, or compound-wound dynamo (generator or receiver) are very handy expressions, and should not be discarded.

16. We have dealt hitherto chiefly with definitions and nomenclature, and have given a few examples: others will occur to every member present. We now come to abbreviations and notation with symbols. The want of uniformity here, and the need for systematising, is still more obvious, but perhaps more difficult to accomplish. Every one admits the great advantage in being able to write down the symbols for chemical elements and their actions and reactions one with the other in the form of simple equations, which any one may comprehend who knows the subject, without a detailed description of what each letter or symbol stands for. Electricians should not rest satisfied until they are supplied with a similar universally-accepted notation, whereby electrical phenomena and actions may be similarly treated. The author submits a sample of what he considers would be useful in this respect. Many of them are taken from Munro and Jamieson's "Pocket-book of Electrical Formulae," where an effort was made to use the same notation and abbreviations.

vations throughout, except in such cases as that of quoting direct from some other author.

It will be observed in this list that in most cases the first English or Greek letter of the word has been used. Those relating to the metric system have been copied from the French edition of Hospitalier's "Electrician's Pocket-book," which are no doubt copied from the list decided upon by the International Commission on the Metre, with a few omissions and additions by the author.

The Greek letters  $\pi$ ,  $\mu$ ,  $\epsilon$  are universally adopted— $\pi$  for the ratio of the circumference of a circle to its diameter,  $\mu$  for the coefficient of friction, and  $\epsilon$  for the base of Napierian logarithms.

#### Metric Abbreviations

|       |     |                    |
|-------|-----|--------------------|
| m.    | for | metre.             |
| cm.   | "   | centimetre.        |
| m.m.  | "   | millimetre.        |
| $m^2$ | "   | metre-square.      |
| $m^3$ | "   | metre-cube.        |
| $c^2$ | "   | centimetre-square. |
| $c^3$ | "   | centimetre-cube.   |
| gm.   | "   | gramme.            |
| mg.   | "   | milligramme.       |
| kg.   | "   | kilogramme.        |
| kgm.  | "   | kilogramme.        |
| &c.   | "   | &c.                |
| temp. | "   | temperature.       |
| res.  | "   | resistance.        |
| g.d.  | "   | gramme-degré.      |
| kg.d. | "   | kilogramme-degré.  |

#### Electrical Abbreviations, Notation, and Symbols

When a capital letter is used for the symbol, then small capitals or italics with suffixes, 1, 2, 3, &c., may be used for parts making up a whole. For example—L for length,  $l_1$ ,  $l_2$ ,  $l_3$ , &c., or  $l_1$ ,  $l_2$ ,  $l_3$ , for different lengths, or parts of L.

#### Fundamental and Derived Mechanical Units

|            |                                     |
|------------|-------------------------------------|
| L          | for Length.                         |
| M          | " Mass.                             |
| T          | " Time.                             |
| V or v     | " Velocity.                         |
| A or a     | " Acceleration.                     |
| F          | " Force.                            |
| $\delta$   | " dyne; e.g. $10\delta = 10$ dynes. |
| W          | " Work.                             |
| w          | " weight.                           |
| ft.lb.     | " foot pound.                       |
| H.P. or HP | " Horse-power.                      |
| I.H.P.     | " Indicated horse-power.            |
| B.H.P.     | " Brake horse-power.                |

#### Other Common Symbols allied to Mechanical Work

|                                  |   |
|----------------------------------|---|
| S                                | for Speed or Stress.  |
| D or d                           | " Diameter.   |
| r                                | " radius.   |
| $\omega$                         | " angular velocity = $2\pi n$ in radians per second.                                      |
| g                                | " acceleration due to gravity.  |
| N or $n_1$ $n_2$ , &c.           | " number of revolutions.  |
| $-^s$                            | " second; e.g. $3^{\text{hr}} 5^{\text{m}} 10^{\text{s}} = 3$ hours 5 minutes 10 seconds. |
| $\tau_1$ $\tau_2$ $\tau_3$ , &c. | " temperatures, absolute.   |
| or $t_1$ $t_2$ $t_3$ , &c.,      | " common.   |

#### Practical Electric Units

The astronomical method of putting the small letters above the line of the figures, as in the case of the example  $3^{\text{hr}} 5^{\text{m}} 10^{\text{s}}$  (3 hours 5 minutes 10 seconds), has not been followed in the following examples, as mathematicians object to the system, the letters appearing as if they were powers. Neither will they readily agree to suffixes, as suffixes have been already adopted by them to distinguish between things of the same kind. The author has therefore written the distinguishing letters on a level with the figures: for example,  $10\omega$  stands for 10 ohms (the methods  $10^\omega$  and  $10\omega$  being both objectionable).

|        |                                 |
|--------|---------------------------------|
| C.G.S. | for centimetre, gramme, second. |
| R      | " Resistance.                   |
| $\rho$ | " specific resistance.          |

$\omega$  for ohm; e.g.  $10\omega = 10$  ohms.  
 $\Omega$  for megohm; e.g.  $10\Omega = 10$  megohms.  
 $C$  for Current.

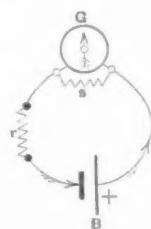
#### Important Electrical Definitions

|  |  |
|--|--|
| A  | " Amperes; e.g. $10A = 10$ amperes.  |
| a  | " milliamperes; e.g. $10a = 10$ milliamperes.  |
| E  | " Electro-motive force, or E.M.F.  |
| v  | " volts; e.g. $10v = 10$ volts.  |
| K  | " Capacity.  |
| $\sigma$   | " specific inductive capacity.   |
| $\Phi$   | " farads; e.g. $10\Phi = 10$ farads.   |
| $\phi$   | " microfarads; e.g. $10\phi = 10$ microfarads.   |
| Q  | " Quantity (coulombs).   |
| P  | " Power.   |
| $W^2$  | " Watts, or Watt power. <sup>1</sup>   |
| W  | " Work in Joules.  |
| H  | " Heat in ".   |
| J  | " Joule's equivalent = $42 \times 10^6$ ergs, or work spent on 2405 gm. of $H_2O$ raised by 1° cent. |
| C = $\frac{E}{R}$  | (Ohm's law).   |
| $E \times C = C^2 R = \frac{E^2}{R} = W^2$   | (Watt powers).   |
| $E C T = C^2 R T = \frac{E^2 T}{R} = E Q = W$  | (Joules).  |
| $\frac{E C T}{J} = \frac{C R T}{J} = \frac{E^2 T}{JR} = \frac{E Q}{J} = \frac{W}{J}$ |  |
| = $W \times 2405 = g.d.$ or grammie degrees.   |  |
| $\epsilon$   | = Electro-chemical equivalent.   |

#### Magnetism

|                     |   |
|---------------------|---|
| N                   | for North pole of a magnet, painted red.                            |
| S                   | " South " blue.   |
| $m$                 | " magnet strength (of pole) or quantity of magnetism.               |
| $l$                 | " distance between the poles of a magnet.                           |
| M or $ml$           | " moment of a magnet.   |
| $\mathfrak{I}$ or I | " Intensity of magnetisation.                                       |
| s                   | " cross section of a magnet.  |
| mp                  | " magnetic potential.   |
| $\mu$               | " magnetic permeability.  |
| $\kappa$            | " magnetic susceptibility.  |
| H                   | " Horizontal intensity of terrestrial magnetism.                    |
| $\theta$            | " angle of deflection.  |
| $d_1$ $d_2$ $d_3$   | " divisions deflection, as in mirror galvanometer.                  |
| $r$                 | " radius (mean) of a coil or solenoid.                              |
| $n$                 | " number of anything; e.g. turns of wire in a coil or galvanometer. |

Take Tangent Galvanometer Formulae, as an example to illustrate the above:—



$$\text{Current, } C = H \frac{r}{2\pi n} \cdot \tan \theta.$$

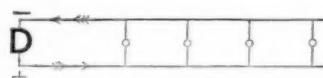
$$G \text{ for Galvanometer or galv. res.} \\ s \text{ " shunt res. for galvanometer} \\ r \text{ " resistance coils} \\ B \text{ " Battery or battery res.} \\ \therefore R = B + \frac{G S}{G + S} + r.$$

<sup>1</sup> By adopting the term "Watt power," there can be no doubt what a Watt means.

<sup>2</sup> See Munro and Jamieson's "Electrical Pocket-book," p. 65.

*Dynamo Circuits Contractions*

Example :—



 or D for Dynamo.

|          |   |                         |
|----------|---|-------------------------|
| T +      | " | Terminal positive.      |
| T -      | " | Terminal negative.      |
| E. M.    | " | Electro-magnet.         |
| or F. M. | " | Field Magnet.           |
| c.p.     | " | candle-power of a lamp. |
| A.M.     | " | Ampere meter.           |
| V.M.     | " | Volt-meter.             |
| S.W.G.   | " | Standard wire gauge.    |

*For use in Formulae*

|  |   |   |
|--|---|---|
| R <sub>a</sub> R <sub>m</sub> R <sub>e</sub> | , | Resistance of armature, magnets, and external circuit respectively. |
| C <sub>a</sub> C <sub>m</sub> C <sub>e</sub> | , | Current in armature, magnets, and external circuit respectively.    |
| L <sub>s</sub>                               | , | coefficient of self-induction.                                      |
| L <sub>m</sub>                               | , | coefficient of mutual induction.                                    |

In the above notation the first letter of the most important words has been used wherever it was found practicable to do so, and the recurrence of the same letter under similar circumstances avoided as much as possible. In cases where no ambiguity can occur, such as H for the heat in Joules, and H for the horizontal intensity of the terrestrial magnetism ; m for metre, and m for magnetic strength of pole ; V for velocity, and v for volts, it will be observed that the same letters appear in each case.

M. Hospitalier, the Secretary for the French Committee on this subject, came over from Paris specially to take part in the discussion, and related what had already been done by him in Paris.

Prof. Forbes, Mr. John Munro, Prof. Ayrton, Dr. Fleming, Prof. Hughes, Prof. Silvanus Thompson, and others took part in the discussion, and generally agreed that a uniform system was much required. The paper, they said, had given a very fair start to this being accomplished.

The author replied that he was glad the Society had agreed so readily to form a thoroughly representative committee, and hoped that their work would be not only speedily accomplished but satisfactory to all concerned.

**THE JUBILEE OF THE STATISTICAL SOCIETY**

THE Statistical Society has been holding a series of meetings during the present week in celebration of the jubilee of its foundation. The meeting is really an International Congress of Statistics, some of the most eminent foreign statisticians being present as the guests of the Society ; among others Sig. Bodio, of Rome ; MM. Keleti, Körösi, and Prof. Neumann-Spöllart, of Buda-Pesth ; Prof. Levasseur and M. de Foville, of Paris ; Gen. F. A. Walker, of the United States, Gen. Liagre, and others. The meetings have been held in the theatre of London University, and several subjects of much statistical importance have been introduced for discussion. One of them was the claim of statistics to be considered as a science, discussed at some length in the address of the President, Sir Rawson W. Rawson. Statistics, as usually treated in this country, little more than the mere calculating of numbers, is a mere mechanical operation ; but which, treated as some of the most eminent statists have treated it, as dealing with the structure of human society, then it certainly becomes amenable to scientific methods. Sir Rawson Rawson referred further to the want of organisation in the collection and publication of official statistics in this country, and rightly advocated reform in this respect. Among the other papers read on Monday were—a sketch of the history of the Society, by Dr. F. J. Mouat ; “Statistical Developments, with special reference to Statistics as a Science,” by Dr. W. A. Guy, F.R.S. ; and on “Statistics and their Enemies,” by M. de Foville. One of the principal papers on Tuesday was by Mr. R. Giffen, on “Some General Uses of Statistical Knowledge,”

in which, among other things, he referred to the rapid increase of the population of Europe during the last century as compared with the increase in China and other Asiatic countries (except India) and in Africa. Should the present rate of European increase continue, the population of our continent in another century will be 1000 millions, whilst that of the United States would be 800 millions. Mr. Giffen maintained that the increase in Europe had been accompanied by a corresponding increase in the means of subsistence and improvement in the position of all classes.

Mr. J. S. Jeans read a paper “On Uniformity of Statistics.” He held the chief *desiderata* required with a view to the improvement and co-ordination of the statistical work undertaken by different Government bureaux were : (1) an agreement as to the major facts necessary to be collected for each special department of statistics ; (2) uniformity in the processes by which these facts were got together ; (3) co-ordination of the methods whereby the materials thus collected were systematised and made use of ; (4) the adoption, as far as possible, of the calendar year as the universal statistical period, so that when comparisons were made they should always relate to the same dates ; (5) the general adoption of the metrical system of weights, measures, and currency.

Herr Körösi spoke “On the Unification of Census Record Tables.” The voluminous and polyglot census results of the world were, he found, practically non-comparable, and he proceeded to sketch a uniform scheme of record tables by which we should arrive at one bound at the highest aim of statistics—the possession of a uniform description of the different nations and of all mankind as regarded sex, age, civil state, illiteracy, occupations, &c.

Mr. F. Y. Edgeworth, in a paper entitled “The Methods of Statistics,” confined himself to the treatment of numerical means. He showed that if we take several means of phenomena belonging to one and the same class (e.g. statures of men), each mean derived from numerous observations, the set of values thus presented would in general fulfil a certain simple mathematical law. The general formula involved a constant or coefficient peculiar to each class of phenomena, which must be discovered by experience. When this operation had been performed we had an apparatus for testing whether any given mean was or was not exceptional, indicative that the set of things of which the *datum* was the mean might [as compared with other phenomena of the same general class] be regarded as belonging to a distinct species. A pretty illustration of important principles was afforded by the statistics of a wasp’s nest, “the image of trade which wasps entering and issuing from their nest present.” It appeared that the exports and imports of this miniature commerce fluctuated with mathematical regularity. As further illustrations of the variety of interests amenable to the general law, he adduced the attendance of the members of a club at a *table d’hôte*, and the frequency of dactyls in the Latin hexameter. The conditions postulated by the Calculus of Probabilities were particularly well exemplified by the fluctuations of the Virgilian rhythm. In conclusion, he alluded to the simpler methods of statistics, and maintained that the mathematical, as compared with the more elementary, organon could produce the same effect with less trouble, or, with the same trouble, greater effect.

M. Emile Levasseur, Member of the Institute and Professor at the College of France, initiated a discussion on the graphic method applied to statistics, exhibiting diagrams and cartograms or statistical maps illustrating his views. Prof. Marshall, of Cambridge, who followed, advocated the use of a standard gauge for historical curves in order to simplify references to the graphic method of statistics, and pointed out dangers in the employment of curves arising from their deceptive appearance to the untrained eye. He suggested ready means of testing the values of curves under comparison.

Yesterday was entirely occupied by a conference and discussion on the subject of an International Statistical Institute, the establishment of which was virtually agreed to.

**UNIVERSITY AND EDUCATIONAL INTELLIGENCE**

CAMBRIDGE.—At the annual election at St. John’s College on June 22, the following awards were made to students of Mathematics, Natural Science, and Medicine :—

Foundation Scholarships.—Mathematics : Love, Fletcher

(each raised to 100.), Bushe-Fox, Kirby, Mossop, Foster Hill. Natural Science and Medicine: Shore, Rolleston, Seward.

Exhibitions.—Mathematics: Holmes, Middlemast, Pressland, Roseveare, Bushe-Fox, Foster, Flux. Natural Science and Medicine: Rolleston, Olive, Jones. Natural Science: Evans, Rendle, Lake.

Proper Sizarships.—Mathematics: Norris, Varley.

Hughes Prizes.—Mathematics: Love. Natural Science: Shore.

Wright Prizes.—Mathematics: Fletcher, Bakre, and Flux (equal).

Herschel Prize (for Astronomy).—Bushe-Fox.

Hockin Prize (for Electricity).—Not awarded.

The Hutchinson Studentship (*Nature*, May 28, p. 90) was awarded to Ds. Rapson (First Class, Classical Tripos 1883-85, and Indian Languages Tripos 1885) to assist him in the prosecution of his studies in Sanskrit literature.

The next Adams Prize will be adjudged in 1887. The subject is Ellipsoidal and Spheroidal Harmonic Analysis, attention being particularly drawn to the reduction of the formulae in this calculus to practical forms adapted to numerical calculation. Since, with the exception of spherical harmonics, this method has remained almost barren in physical investigations, actual illustrations of its utility are invited. The essays must be sent in by December 16, 1886, and any Cambridge graduate may compete. The successful candidate will receive 170*l.*; he must print the essay at his own expense.

The Mathematical Board recommend that four separate examiners be appointed for the final portion of the Mathematical Tripos, in the hope of inducing more specially qualified professors and specialists to undertake this advanced work.

The Annual Report of the Observatory gives a very satisfactory record of progress. Among the 3253 observations with the transit circle were 2442 of zone stars on 100 nights, the greater number at five or seven wires, and all read off with four microscopes. The reductions of observations are in a forward state.

At the Botanical Gardens during the past year the collection of insectivorous plants has been greatly improved. A number of new or rare species have flowered—some for the first time in this country. A speciality has been made of *Salvia*, and four species from this garden have been figured in the *Botanical Magazine*.

A grant not exceeding 100*l.* is to be made to C. S. Sherrington, M.B., of Gonville and Caius College, from the Worts Travelling Scholars Fund, to enable him to proceed to Valentia to investigate the experiments now being made by Dr. Ferrand on inoculation as a preventive against cholera.

#### SCIENTIFIC SERIALS

In the *Journal of Botany* for May and June Mr. W. B. Grove continues his paper on "new or noteworthy fungi," which is well illustrated. Several new species are described, and one new genus, *Diplococcum*, near to *Cladotrichum*.—Mr. S. Le M. Moore identifies *Bacterium fexidum*, Thin, found in association with profuse sweating of the soles of the feet, with the ordinary micrococcus of surface soil.—Mr. H. N. Dixon adds a new species to the British moss flora, *Catharinea dixonii*, from Northampton.—Mr. R. D. Fitzgerald and Mr. H. N. Ridley describe new Orchids; and Rev. B. Scortechni a new genus of Myrtaceæ, *Pseudoeugenia*, from the Malay Peninsula.—Dr. H. Trimen sends some notes on the flora of Ceylon, and Rev. W. H. Purchas contributes notes on Dovedale plants.

*Rivista Scientifica Industriale*, May 15.—A new explanation of the red after-glow (continued), by Prof. Carlo Marangoni.—On the diathermicity of fluids, by A. Volta.—Some electric phenomena associated with rarefied gases, by Emilio Piazoli.—Variations in the electric resistance of solid and pure metal wires according to the temperature (concluded), by Prof. Angelo Emo.

*Bulletin de l'Academie Royale de Belgique*, April 4.—Crystallographic note on some specimens of calcite from the Carboniferous limestone of Blaton.—Note on the recent appearance of a school of whales (*Balaena biscayensis*) on the east coast of the United States, by M. P. J. Van Beneden.—Account of the discovery of a gigantic Mosasaurian (*Hainosaurus*) in the chalk formation of Mesvin-Ciply near Mons, Belgium, by M. E. Dupont.—On Riccati's equation and its double generalisation, by M. J. de Tilly.—State of the vegetation during the month o-

March at Liége and Longchamps-sur-Geer, Belgium, by Baron de Sels Longchamps.—On the presence of Condroz graywacke in the neighbourhood of Beaumont, Entre-Sambre-et-Meuse, by M. Michel Mourlon.—On the porphyries of Bierghes, by M. A. Renard.—On the tension of saturated vapours: a modification of the atomic law of Dalton, by M. P. de Heen.—The Roumanians in the Middle Ages: a historical puzzle, by M. A. D. Xenophol.

#### SOCIETIES AND ACADEMIES

##### LONDON

**Royal Society**, June 18.—"The Action of Tidal Streams on Metals during Diffusion of Salt and Fresh Water. Experimental Research, Part II. (Gravimetric)." By Thomas Andrews, F.R.S.E. Communicated by Prof. G. G. Stokes, Sec.R.S.

In a paper last session on "The Electromotive Force during Diffusion in Tidal Streams" (see *Proc. Roy. Soc.*, No. 232), the author recorded the electrical part of this investigation. The present communication contains the concluding gravimetric experiments of the research. The effects attending the diffusion of the salt and fresh water in tidal estuaries, on parts of the same metal, of known composition and general properties, were estimated in each case for a period of *one year*, during which bright plates of the following metals—viz., wrought iron (combined carbon, none), "soft" Bessemer steel (c.c. 0'15), "soft" Siemens-Martin steel (c.c. 0'17), "soft" cast steel (c.c. 0'46), "hard" Bessemer steel (c.c. 0'51), best cast metal, "No. 1" (c.c. 0'39), common cast metal, "No. 2" (c.c. 0'67), were constantly exposed to conditions of galvanic action similar to those obtaining in some tidal streams. The results demonstrate that electric disintegration of the nature alluded to in this and the former paper (viz., the galvanic destructive action on parts of even the same metal, arising from difference of electrical potential during diffusion between the surface and lower waters in a tidal stream) is, on comparison with other investigations by the author, apparently of much greater extent than the loss either from simple corrosion in sea water alone, or than that which ensues from the action on each other of dissimilar metals of this group (such as wrought irons, cast metals, and steels) in galvanic connection in sea water. Compared with simple corrosion in sea water only, the increase in loss varied from about 15 up to 50 per cent., according to the nature of the metals. The results of the experiments in this and the former paper indicate, therefore, that the tidal action on any vessel or metallic structure, of sea and fresh water whilst diffusing is (in the case even of the same metal thus exposed to the simultaneous action of top and bottom waters) considerably more destructive in its nature and character than the action of sea water alone. Moreover, the author has found it (in other experiments) extending over long periods to considerably exceed (in some instances varying from about 55 to 120 per cent.) the loss caused by galvanic action between dissimilar metals of the iron and steel group in circuit in sea water.

**Geological Society**, May 27.—Prof. T. G. Bonney, F.R.S., President, in the chair.—George Ormond Kekewich was elected a Fellow of the Society.—The following communications were read:—On the so-called diorite of Little Knott (Cumberland), with further remarks on the occurrence of Picrites in Wales, by Prof. T. G. Bonney, F.R.S., Pres.G.S. The Little Knott rock and its microscopic structure were briefly described by the late Mr. Clifton Ward, who named it a diorite, but called attention to its abnormal character. The author gave some additional particulars, and showed that, although the rock varies in different parts of the same outcrop, and is not one of the most typical representatives of the picrite group, its relations on the whole are with this rather than with the true diorites. He also called attention to the extraordinary number of boulders which have been furnished by this comparatively small outcrop, and discussed the relation of their distribution to the former extension and effects of ice in the Lake District. He briefly noticed the occurrence of additional boulders of picrite in Anglesey, and described specimens from two localities (Caemawr and Pengorffwysa) where a similar rock has been discovered *in situ* by Prof. Hughes. Hence it is probable that the Anglesey boulders are derived from localities in that island, and not from Cumberland. From a re-examination of specimens collected by the late Prof. Sedgwick and Mr. Tawney, preserved in the Woodwardian Museum at Cambridge, the author showed that the rock must occur *in situ* in two localities in the Lleyn

peninsula—in the neighbourhood of Clynnog and of Aberdaron. Lastly, he described a very remarkable picrite boulder, discovered by Dr. Hicks, which rests on "Dimetian" rock at Porthlisky near St. David's.—Sketches of South-African Geology; No. 2, a sketch of the gold-fields of the Transvaal, South Africa, by W. H. Penning, F.G.S. The gold-fields of the Transvaal have been defined as covering nearly all the eastern and northern districts of the State, though but a small portion of the area is productive. In this paper the author described only the Lydenburg and De Kaap gold-fields, leaving those of Pretoria and Marabastad for a future communication. The auriferous region is known to extend 350 miles to the northward beyond the Limpopo River, so that the gold-bearing rocks are found throughout at least  $7\frac{1}{2}$  degrees of latitude and 3 of longitude. The area of the two gold-fields mentioned, comprising together about 3000 square miles, was defined; and the author, after noticing some old gold-workings, proceeded to give an account of the physical features of the country. He especially called attention to the circumstance that most of the rivers rise to the west of the highest range, and flow eastward through it. The oldest gold-bearing rocks consist of unfossiliferous schists, shales, cherts, and quartzites, classed by the author as Silurian. Amongst these a great mass of coarse granitic rock is intruded, consisting of quartz and felspar, with but little, if any, mica. This granite, in the De Kaap valley, forms an ellipse seventeen miles long by ten broad, with a narrow northerly prolongation. Both the granite and the stratified rock are traversed by intrusive dykes, chiefly of diorite. These beds have been much disturbed and then cut down, probably by marine denudation, to a level plain 1700 or 1800 feet above the sea. Upon them rest unconformably a great sequence of conglomerates, sandstones, and shales, the "Megafiesberg beds" of a former paper, but now provisionally classed as Devonian. These rocks also are traversed by dykes of diorite and other kinds of trap. The "High Veldt beds" overlie the "Devonian" with some unconformity. Several sections and observations illustrative of these facts were described, and details were given of the different gold-mines in each of the great systems noticed, and also in alluvial deposits. It was shown that much gold was derived originally from veins in the older or Silurian rocks, and that some of that met with in the newer system occurred in conglomerates or other detrital beds. But there are also gold-bearing quartz-veins intersecting the latter.—On some erratics in the boulder-clay of Cheshire, &c., and the conditions of climate they denote, by Charles Ricketts, M.D., F.G.S.

**Royal Meteorological Society, June 17.**—Mr. R. H. Scott, F.R.S., President, in the chair.—Lieut. A. Leeper, R.N., was elected a Fellow of the Society.—The following papers were read:—A few meteorological observations made on a voyage up the Nile in February and March, 1885, by Dr. W. Marctet, F.R.S. The author, on a voyage up the Nile from Cairo to Assouan, made a series of meteorological observations, and in the present paper gives the results of those relating mainly to nocturnal radiation and the temperature of the water of the Nile.—The mean direction of cirrus clouds over Europe, by Dr. H. H. Hildebrandsson, Hon. Mem. R. Met. Soc. The author has collected a number of observations on the movements of cirrus clouds over various parts of Europe, and after discussing them has arrived at the following results: (1) the mean direction at all stations lies between south-west and north-west; (2) in winter the cirri come from a more northerly direction, and in summer from a more southerly; (3) in winter the northerly component is greater than the Baltic and the north coast of the Mediterranean; (4) the mean directions of the upper currents nearly coincide with the mean tracks of storm-centres; (5) the upper currents of the atmosphere tend in general to flow away from those areas in which a barometrical depression exists at the earth's surface towards those in which there is an elevation of pressure.—On the influence of accumulations of snow on climate, by Dr. A. Woeikoff, Hon. Mem. R. Met. Soc.—Note on the weather of January, 1881, by Mr. E. Harding, F.R. Met. Soc. It will be remembered that the weather of January, 1881, was remarkable for the prolonged and exceptionally severe frost, the heavy gale of the 18th and 19th, and the snowstorms. The author has prepared isobaric charts for the North Atlantic and adjacent continents for January, 1881, and compared them with similar charts for January in other years. He shows that the severe weather in 1881 was due to a reversal of the normal conditions, the atmospheric pressure being high in the north and low in the south.—Results of meteorological observations made in the Solomon Group, 1882-84, by

Lieut. A. Leeper, R.N.—Graphic hygrometrical table, by Mr. D. Cunningham, M.Inst.C.E., F.R. Met. Soc.

**Geologists' Association, June 5.**—Wm. Topley, F.G.S., President, in the chair.—A paper was read by Mr. Herbert Goss, F.L.S., on some recently-discovered Insecta and Arachnida from Carboniferous and Silurian Rocks. The author stated that in 1879 only 103 fossil insects from the Carboniferous rocks of the whole world were known, but during the last five years a great number had been discovered, including about 1400 from Compton, France, a few from Saarbrück, Klein Opitz, Lugau, and elsewhere on the Continent of Europe, and a considerable number from various parts of the North American Continent. The specimens were enumerated, some of the most remarkable forms were referred to in detail, and attention was drawn to their affinities with existing types. Many of the specimens were of gigantic size and in a fine state of preservation, and whilst the majority of them appeared referable to forms allied to existing genera of *Hemiptera*, *Neuroptera*, and *Orthoptera*, a considerable number consisted of synthetic types intermediate between these orders, uniting in themselves certain peculiarities of structure now characteristic of distinct orders. Attention was also called to the recent discovery of fossil scorpions in the Upper Silurian of the Isle of Gotland and Scotland, and the wing of a cockroach in the Middle Silurian of Jurques, Calvados, France. Prior to these discoveries no remains of terrestrial animals had been obtained from any strata older than the Devonian, and the result of their discovery in Silurian strata was to leave the *Insecta* the oldest known class of land animals, and the *Blattidae* the oldest family of insects. The evidence afforded by Palaeontology was therefore, as far as it went, in support of the views as to the origin of insects and the order of succession of the various groups previously arrived at from a study of the embryology of the class.

#### EDINBURGH

**Royal Society, June 1.**—Robert Gray, Vice-President, in the chair.—The Astronomer-Royal for Scotland showed the solar spectrum, as observed last year by him, drawn to scale 80 feet long. He contrasted it with the spectrum as seen by Fizeau, and with that as seen by himself some years ago, a special object being to determine the effect of the present cosmic dust.—Prof. Tait gave a number of perfectly general methods of enumerating the amphicheiral knots of any order, and pointed out the curious fact that amphicheirals may in many cases be transformed into other amphicheirals, sometimes in more than one way.—Mr. Hugh Robert Mill, B.Sc., communicated a paper on the chemistry of Japanese lacquer (*Urushi*), by Mr. Hirokuro Yoshida, chemist to the Imperial Geological Survey of Japan. Lacquer juice was found to consist of a monobasic acid (*Urushic acid*), a small proportion of a nitrogenous diastatic matter, gum arabic, and water. The hardening of lacquer was shown to be due to the oxidation of the urushic acid to oxyurushic acid by the action of the nitrogenous substance in the presence of air and moisture, a number of experiments distinctly proving that it was not a case of hydration. Coloured lacquers are made by the addition of metals, their sulphides, or oxides, to the juice, which exerts no action upon them, except in the case of *voiro* or black lacquer, the colour of which is due to the presence of urushiate of iron produced by the addition of iron filings to the juice.—In a paper on atmospheric electricity at Dodebetta, Prof. C. Michie Smith pointed out that the forenoon observations show a mean curve of atmospheric potential rising to a maximum at about the period of maximum temperature. There is probably a much less marked night maximum, with, of course, a minimum between each maximum. From observations made on some exceptionally fine days, an afternoon curve was constructed. The afternoon observations, however, were usually much modified by mists, but the important fact was established that the potential was regularly less than the normal in a dissipating mist, and much above the normal in a condensing mist.—The Astronomer-Royal for Scotland exhibited a series of star-photographs.

#### PARIS

**Academy of Sciences, June 15.**—Note on MM. Paul and Prosper Henry's apparatus for photographing the heavenly bodies, by M. Mouchet. The author presented to the Academy the already executed chart of a section of the Milky Way, including about 5000 stars from the sixth to the fifteenth magnitude comprised in the space between  $2^{\circ} 15'$  right ascension and  $3^{\circ}$  declination. To complete the representation of the 41,000 superficial

degrees of tions form undertaken hemispherical years. Some million st bequeathed regions at the greatest on the st to physi Emile Bla fauna of Madagascar fourth part on the se presented searches —Observ Observatory —Observ Algiers (on the pr confirmatory theory on —Note on radiant m sanarium anomalous draws the analysis spectroscopic last court of ammonium from the meth volatility the pre geniculat research ganglion of the hi Physiol of the D Echinida Of the f four are the Terti survive tions in n on both of plants artificial A. de S tions of Macphae Phys results have been est patholog pressure Herr G the ante connect the eye living ca death of blood-p ocular p the pre lessen the the trig likewise pressure was a d somewhat influen

degrees of the firmament there will be needed 6000 similar sections forming 1500 of our ecliptical charts. Were the work undertaken by six or eight observatories well situated in the two hemispheres, the whole might be concluded in about five or six years. Such a work, containing the photographs of over 20 million stars down to the 14th or 15th magnitude, and bequeathing to future astronomers an exact picture of the starry regions at the close of the nineteenth century, would certainly be the greatest astronomic undertaking ever carried out.—Remarks on the study of the various floras and faunas in their relations to physical geography and the geology of the globe, by M. Emile Blanchard.—Remarks on M. Alfred Granddidier's "Avifauna of Madagascar," completing the third and last volume of that naturalist's great work on the "Physical and Political History of Madagascar," by M. Alph. Milne-Edwards.—Note on the fourth part of the Map of Algeria to the scale of 1 : 50,000, and on the second and third sheets of the Ordnance Map of France, presented to the Academy by M. Perrier.—Experimental researches on the diphtheric affections of animals, by M. G. Colin.—Observations of Palisa's new planet 248, made at the Paris Observatory (equatorial of the west tower), by M. G. Bigourdan.—Observations of the same planet made at the Observatory of Algiers (0'50 m. telescope), by M. Ch. Trépied.—Experiments on the propagation of waves along the course of rapid streams: confirmation of the formulas given by M. Boussinesq in his theory on the gradually varied movements of fluids, by M. Bazin.—Note on spectroscopic observations through the medium of radiant matter: mutual extinction of the spectra of yttrium and sanarium, by M. William Crookes. From the numerous anomalies presented during his present experiments, the author draws the important inference that the conclusions of spectrum analysis *per se* are liable to serious error unless at each step the spectroscopist is controlled by the chemist, who represents the last court of appeal.—On the action of cadmium on the nitrate of ammoniac, by M. H. Morin.—Note on the sulphur derived from the persulphuret of hydrogen, by M. Maguenne.—Note on the methylate of soda, by M. de Forcrand.—On the degree of volatility in the chlorurated nitrates, by M. L. Henry.—On the pretended elective fermentation, by M. Mauménil.—On the geniculated ganglion of birds, by M. L. Magnien. From his researches the author finds that in birds there exists a facial ganglion, which must be assimilated to the geniculated ganglion of the higher vertebrate animals.—Note on the nervous system of the Buccinidae and the Purpuridae, by M. E. L. Bouvier.—Physiology of the composite Ascidiæ belonging to the family of the Diplosomidae, by M. S. Jourdain.—Considerations on the Echinidae of the Jurassic formations in France, by M. Cotteau. Of the fifty genera belonging to the Jurassic formations twenty-four are peculiar to this geological system; four only persist to the Tertiary epoch, and two alone (*Cidaris* and *Stomachinus*) survive to the present time.—An attempt to determine the variations in the length of time during which the human body rests on both feet while walking, by M. Demyen.—On the respiration of plants, by MM. G. Boneier and L. Mangin.—Note on the artificial production of Strengite ( $(Fe_2(PO_4)_2 + 4H_2O)$ ), by M. A. de Schulten.—Symmetrical disposition of the archaic formations on both sides of the Guadaluquivir Valley, by M. J. Macpherson.

## BERLIN

**Physiological Society, May 15.**—Dr. Höltzke spoke of the results of his investigations into intraocular pressure. It having been established that glaucoma was developed in the eye through pathologically increased pressure, the question of physiological pressure in the eye was of high practical importance. Yet was Herr Grünhagen the first, by means of a canula introduced into the anterior chamber of the eye, and a fine mercurial manometer connected with it, to measure the magnitude of this pressure in the eye of a cat and to determine its variations. He found the living cat's eye showing a pressure of 26 mm., which, on the death of the animal, sank to 10 mm. Everything increasing the blood-pressure was found to augment at the same time the intraocular pressure, while, on the other hand, everything lowering the pressure in the province of the carotid artery was found to lessen the pressure in the chamber of the eye. Stimulation of the trigemini raised the intraocular pressure considerably, as did likewise stimulation of the medulla oblongata, which pushed the pressure up to as high even as 200 mm. The effect of atropine was a diminution of pressure. A few later observers had, with somewhat modified manometers, attained like results for the influence of the blood-pressure and deviating results for that of

the nerves and the alkaloids. Dr. Höltzke had in his investigations, which first of all referred to the effect of the alkaloids atropine, eserine, and pilocarpine, laid special weight on the improvement of the methods, and on one hand had, as a trustworthy measurer of pressure, made use of a double manometer, which he produced and explained to the Society, and on the other hand had confined the application of the alkaloids above mentioned to one eye, while the other eye was utilised in the way of control in the process of the measurements which were always carried out in both eyes. As the result of the measurements it was ascertained that eserine produced at first a considerable augmentation of the pressure, and then an abatement of it to a point below the normal value. Pilocarpine produced similar, but more reduced results; while atropine called forth quite the contrary effects. The speaker had further determined the pressure, still more directly concerned in the case of the production of glaucoma, in the vitreous humour, by means of a special canula, and with the same measurer of pressure. In this case he had found the pressure, both under normal conditions, as also under the operation of the alkaloids, and the changes of pressure in the blood, to be always similar to the pressure in the anterior chamber of the eye.—Dr. Virchow described the relation of the blood-vessels of the vitreous humour in cyprinoids. After having shown that the occurrence of blood-vessels in the vitreous body, and its absence from the retina was not a distinguishing character of the amphibia, seeing that blood-vessels in the vitreous humour were wanting in the case of many amphibia and reptiles, as also in the lowest fishes, while in other classes of amphibia such blood-vessels were to be found. The speaker commented minutely on the differences in the ramification and diffusion of these blood-vessels, as also the varying arrangement of their capillaries, and demonstrated them on preparations of carps, bleaks, and roaches, as well as by enlarged photographs.—Dr. Weyl reported on the negative results of experiments having for their object to ascertain the mode of nitrates in the animal body. It was a well-known fact that nitrates occurred in human urine, but were regularly wanting in the urine of dogs. By feeding dogs with ammoniacal citric acid a nitrate formation was not produced, not even when, along with the ammonia, a fixed alkali was administered by way of combining the acids arising under the flesh aliment. Only in a pathological case, in which a dog that had received ammonia died of a disease of the intestine and the kidneys, was nitrate found in the urine; consequently neither the mode of the formation of nitrates in the organism nor the cause of the difference between man and dog in this respect had been ascertained. For the demonstration of nitrates in the urine the speaker recommended distilling the urine with sulphuric acid, and treating the distillation with one of the many reagents of nitric oxide.—Dr. Friedländer demonstrated a case of carcinoma hitherto never observed in a pulmonary cavern. The carcinoma adhered firmly to the wall of the tubercular cavity, sent a stalk through the next branch, and at the stalk hung a somewhat large carcinomatous swelling in the bifurcation. The carcinoma was a horny carcinoma which was regularly observed at those places where stratified flattened epithelium occurred; on other membranes horny cancer had hitherto never been observed. So much the more striking, therefore, was it to find horny carcinoma in the lungs. This riddle perhaps found its explanation in two observations noted down in the literature of the subject, according to which defects in mucous membranes caused by abscesses, once in the lungs and once in the corpus uteri, became healed over by flattened epithelium instead of by cylindroid or ciliated cells. It was possible that the cavity occurring in this case also had covered itself with flattened epithelium which had become the starting-point for the horny carcinoma.

**Physical Society, May 21.**—Dr. Kayser demonstrated a new cathetometer constructed by Herr Bamberg, explained the arrangement of it, and set forth as its special advantages the facility of placing it vertically and the circumstance that after precise adjustment, by merely changing the eye-pieces, the instrument could be used both as a microscope and a telescope, without at all altering its position for the least as for the greatest distances.—Prof. Neesen sketched a very simple arrangement for demonstrating the effect of the lightning-conductor, which was particularly well qualified for class experiments.—Dr. König discussed the principle according to which he was getting a new spectro-photometer made, which he showed to the Society, proportionally put together. The instrument consisted in the main of

an objective tube containing a lens and a diaphragm turned towards the source of light with two slits lying above each other, a prism for decomposing the two bundles of incident rays, and a second collimator tube, on the lid of which closing the end appeared two spectra showing an interval between them. Before the lens of the ocular collimator was placed a twin prism, the two prisms of which with their refracting edges of  $1^{\circ}$  to  $2^{\circ}$  were cemented together. By this twin prism each spectrum was decomposed into two spectra, and the dimensions of the twin prism were determined in such a manner that on the lid of the collimator one spectrum was situated above, the other below, while in the middle the second spectrum of the upper slit coincided with the second spectrum of the lower slit. In the lid of the ocular tube let a small opening be made cutting off a small piece of determinate wave-length from the double spectrum; on looking through it the field of vision would be seen divided by a line (the refracting edges of the twin prism) into two halves, both of the same colouring. Before each of the two slits of the objective tube through which the light entered was placed a Nicol prism in such a position that perpendicularly polarised light entered one slit and horizontally polarised light the other. The middle compound spectrum consisted, therefore, of a perpendicularly and a horizontally polarised spectrum, and in the field of vision the two like-coloured halves were also polarised perpendicularly to each other. If now the field of vision was viewed, not directly, but through a Nicol prism, then, according to the position of this prism would the one half at one time, the other half at another time, be withdrawn from sight; and if the two entering rays of light or their spectra possessed different degrees of intensity, by turning the ocular-Nicol the two halves of the field of vision could be made equal, and from the rotation the relative degrees of intensity of the two bundles of rays could be determined.

## VIENNA

**Imperial Academy of Sciences**, April 16.—Studies on the fauna of eighteen smaller and larger Austrian freshwater basins, by O. E. Imhof.—On the action of potassium permanganate on hyposulphite of soda, by M. Gläser.—On orthoclase as a dry mineral in basalt, by V. v. Zepharowich.—On jointed mill-sap vessels in the fruit of *Lactuca deliciosa*, by A. Weiss.—On the relation of Weber's theory of electro-dynamics to Hertz's principles of the unity of electric forces, by E. Aulinger.—A contribution to knowledge of the fishes of Turonian system of Bohemia, by G. Laube.—On the astronomical data found in Assyrian inscriptions, by T. Oppert.—On a new method for determination of the size of molecules, by F. Exner.—On a new trinitrophenol, by T. Zehenter.—Astronomical researches on the Egyptian eclipse referred to in the Bible, by E. Mahler.

April 23.—On spectrographical experiments on normal light sources, and on the applicability of the latter for photo-chemical measurement of light-sensitivity, by T. M. Eder.—The knowledge of the anatomical structure of our Loranthaceæ, by G. Marktanner-Turneretscher.—Researches on chelidonic acid, by L. Haizinger and A. Lieben.

May 7.—On the manufacturing and qualitative composition of zirkon, by E. Linnemann.—Systematic zoological studies, by F. Brauer.—On artificial uric and methylated uric acids, by T. Horbaczewsky.—On polaristrometric methods, especially on "polarimètres à pénombres," by F. Lippich.—Contributions to a knowledge of the cobalt ammonium compounds, by G. Voltmann.—On the knowledge of the structure of the Libanon and Antilibanon, by E. Suess.—On the solution of Kepler's problem, by Th. von Oppolzer.—On the chlorhydrines of butyryl-glycerin, by A. Lieben.—On a crocodile skull found in the Tertiary deposits of Eggenburg, Lower Austria, by F. Toula and A. Kail.

May 14.—On the product of oxidation of propylene oxide by silver oxide, by E. Linnemann.—Preliminary communication on the fluorescence of the dyeing matters of fungi, by A. Weiss.—The knowledge of the structure of the muscles of insects, by R. von Limbeck.—On the sinus cavernosus of Dura mater, by C. von Langer.—On papaverine, by V. Barth and G. Goldschmidt.

May 20.—Prof. Stefan was elected Vice-President of the Mathematical Class; Prof. E. Suess, Secretary; Prof. L. Boltzmann (Gratz), Prof. V. von Zepharovitsch (Prague), and Prof. C. Claus (Vienna) were elected Members; Prof. Escherich, Prof. A. Vogl, and Franz Exner (Vienna), Correspondents; Prof. A. Bayer (Munich), Prof. T. D. Dana (New Haven), Foreign Correspondents.

May 21.—Anniversary Meeting.—The opening address was held by the Curator's substitute, A. von Schmerling. Then the reports were read by the General Secretary, Prof. Siegel, and by the Secretary of the Mathematical Class, Prof. Stefan. Obituary notes were given by the latter on Hochstetter, Fitzinger, F. von Stein, and Siebold. A prize of 1000 florins was awarded to R. Maly (Gratz), for his paper, "Researches on the Oxidation of Albumens by Potassium Permanganate."

## STOCKHOLM

**Academy of Sciences**, May 18.—For the *Transactions* of the Academy were accepted: Researches on the disjunctive electromotive power on the electrodes during the passage of electricity through air of greater or lesser density, by Prof. Edlund; and Ueber die Säugethiergattung *Galeopithecus*: eine morphologische Untersuchung, by Prof. W. Peche.—Prof. Edlund exhibited and described a specimen of meteorograph of Thorell's construction, made by Herr Sörensen for the Emperor of Brazil.—Prof. Warming gave an account of the botanical researches undertaken by Messrs. L. Y. Neumann and G. A. Tiselius in the Swedish provinces of Jemtland and Medelpad; and (2) contributions to the knowledge of the structure of the pericarp, by Miss Alida Olbers.—Prof. Toreell exhibited and described a geological map of Sweden, on the scale 1 : 600,000.—The Secretary, Prof. Lindgren, presented for publication in the *Transactions* the following papers:—The transversal oscillations in a thin crystalline lamina with three plans of symmetry and elliptical limitation, by E. Sundberg.—Alpha-oxazonaphthalin alpha-sulphonacid and some of its salts, by Dr. J. E. Alén.—On two isomeric beta-monochlor-naphthalin-sulphonacids, by Herr K. Arnell.—On mononitro-beta-naphtha-acids, by Dr. A. G. Ekstrand.—Some annotations on microscopic researches on plants, by Dr. A. Malm.—Contributions to the flora of fungi in the southernmost parts of Norway, by Dr. E. Henning.—On Sowerby's whale, by Dr. A. Malm.

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